THE

ELECTRICAL REVIEW.

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THE

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1902 Edition

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STANDARDISATION.

NEW ideas are always apt to be overdone. So it is with the idea of standardisation, which is new to some people. Horse nails and tinned tacks and thousands of similar articles are already reduced to standard, and it is always a desirable thing to widen the area of standardisation; it is ridiculous that to-day there should be so many rail sections and such a wide assortment of girder sections. At the meetings of the Institute of Naval Engineers in January last the question of standardisation was raised by Sir Walter Peace, who, as the agent of an important Colony, often had to order material in this country, and no doubt ran across the item of standards, or the want of them, fairly often. As is well known, a Joint Committee of the engineering institutions is now sitting on the question, and a deputation from this Committee waited upon Mr. Balfour and Mr. Arnold Forster last week.

Now there is just a chance that the idea may be carried too far. Thus Mr. Swinburne asked for standard engines and dynamos, and told us what we seem to remember as a twice-told tale, that the electrical industry is in its infancy.

We may tell Mr. Swinburne that, if this be so, it is a little early to begin to standardise things so thoroughly as he would have them done. We believe little dogs are kept to standard by the aid of gin, and to standardise an infant implies a gin effect. It would be better to standardise the parents of the infant, and so in engineering what is wanted is a standard quality of steel for boiler plates, a standard steel for axles, for tires, for bolts, for structural sections, and so on.

The delay in building locomotives begins with the boiler plates, if these must be to a special analysis, for the construction cannot be commenced until the boiler plates are rolled. Specially specified steel for plates or axles or other things cannot be bought from manufacturer's stock. It is in the raw materials of manufacture that standardisation is most needed. In the constructed articles themselves it is of less importance, but when a constructed machine is tied down to minutiæ of detail, according to specification, then trouble begins. Mr. Swinburne is asking too much when he wants engines and dynamos fixed to standard. These things are not yet perfected, and cannot be fixed. Practice is gradually bringing all such things into line, and manufacturers, in their own interest, are doubtless trying to narrow their products. We are not prepared to say that the high-speed engine will or will not endure, but it has obtained a great hold, and has done much to show what can be done by high rotative speed. At one time it was strongly urged that no double-acting engine could run so fast as a single-acting engine. To-day, under the spur of competition, the double-acting engine runs at higher speeds than any other. Are we to reject the steam turbine because it is not to standard? Such are not our ideas of standardisation.

We see a field of ample area in the directions already indicated. The Egyptian locomotive report, which showed the dismal failure of American standard locomotives, is but one of the many arguments against illogical extension of the principle. Doubtless the more successful English work would have been considerably cheapened if a rational amount of standard material had entered into its construction, and if English builders of machinery could use their own standard designs more freely much expense would be saved. There is no attempt made in America even to standardise things like engines. Railroad cars and their details are made to certain standards, especially in certain parts, so that the cars of different makers are interchangeable. This is seen to by the Master Car-builders' Association, and the first thing to be done is for makers to meet and agree on standard parts; but even then, what about the foreigner? Suppose that all English makers refused to tender to a non-standard specification; the order would go to Germany. Indeed, when an engineer had made up his mind to send an order to Germany, he would know how to find an excuse for doing so by demanding parts that were not to standard. How is this to be guarded against? There are already in our midst foreign engineers who strain every nerve to favour foreign firms at any cost.

This sort of thing cannot well be exploited in foreign countries, for protective tariffs enable the Americans or the Germans to refuse to tender unless to standard. We do not urge protection, but if any manufacturers' association were to form a combination to fix standards, there would be many who would support any policy that enabled such standards to be enforced by a tariff on foreign goods that were not to standard. Only by some such means could standards be enforced, for it would defeat all the benefits if some opinionated pedant could break through the standard by passing orders abroad.

Some of the matters found in specifications are more suited to the pages of a comic paper than to the dry and solid pages of the Review, as one of our contemporaries would perhaps phrase it; were instances specified, they would be recognised, but some of the items that have been brought to our notice are really, in a sense, unfit for publication.

Ignorance in commercial matters is, no doubt, often a reason for foolish specifications. Ignorance of the details of construction and of working of apparatus is another reason. What would be thought to-day of a specification for incandescence lamps with bases not to standard? Yet older and long-standardised articles are still asked for to special patterns that have no reason for the asking. But there are limits to the fixing of things that are perfectly recognised by men of intelligence or reasonable modesty. Where engineers go outside these reasonable limits, they usually suffer from a great opinion of themselves, and like to write themselves large on all they have to do with, like the scribbling tourist.

PATENTS.

If we assume that the number of patents taken out in connection with an industry is a measure of its activity, some useful information on this question will be found in the recently issued report of the Comptroller-General of Patents. The numbers of patents sealed in each of the 146 classes into which inventions are divided by the Patent Office is given in tabular form for each year from 1885 to 1900. Comparing the numbers of patents in 1900 with those in 1899, we find that in the class dynamo-electric generators and motors there was an increase of 7 per cent.; in electricity, conducting, &c., an increase of 17 per cent.; in electricity, measuring, an increase of 10 per cent.; in electricity, regulating, an increase of 5 per cent.; in electric lamps, &c., an increase of 5 per cent.; in electric telegraphs, &c., an increase of 1 per cent.; in electrolysis, an increase of 11 per cent.; in galvanic batteries there is a decrease of 8 per cent. It is evident from these figures that all the principal branches of the electrical industries, except galvanic batteries, are in a progressive condition. Electric traction does not form a separate class, so that an exact statement of the progress of invention in this department cannot be arrived at from the table, but the Comptroller states in his report that the attention of inventors has been specially directed to this subject both in 1900 and 1901, the protection of the public from accidents due to broken wires being a favourite subject. The rise of the motor car industry has led to a great increase of patents in connection with this industry, while the enthusiasts who, three or four years ago, overwhelmed the Patent Office with cycle inventions have evidently subsided—the patents in this class in 1900 are only 36 per cent. of the number sealed in 1897.

The figures given in the report with regard to oppositions to the granting of patents are of special interest in connection with the proposal which is now before Parliament for an official examination as to novelty. Between 1894 and 1901 about 1 in every 200 applications was opposed before sealing. This opposition can only be made by a party interested in an earlier patent for the same invention, or by a party from whom the invention has been obtained by fraud. The public, who have most interest in the suppression of bogus patents, have no *locus standi* in the Comptroller's Court. Sir Edward Fry's Committee found that more than 40 per cent. of the patents granted were wanting in novelty, and at present the sole available process of preventing the sealing of a bogus patent results only in the suppression of less than ½ per cent. Evidently, it should be open to any member of the public to oppose the sealing of a patent, or else the Patent Office itself should protect the public from being blackmailed by the bogus patentee. The surplus of receipts above payments in 1901 was over £107,000, a sum which should either be spent for the benefit of inventors, or remitted from the fees. There is no justification for a special tax on invention.

ELECTRONS.

If the nineteenth century may be called the century of atoms, it looks as if the twentieth century is to be the century of electrons. A luminous article on the new electronic theory of electricity by Prof. Fleming will be found in the *Popular Science Monthly* for last month. The facts about electrons and their relations to atoms, as far as they have been ascertained, are clearly explained and are fairly intelligible, but the theories which have been advanced to

explain the peculiar behaviour of electrons leave us in a hopeless haze. Helmholtz made us familiar with the idea of the electron, or as he called it, the atom of electricity, and showed that it was a necessary assumption to explain the phenomena of electrolysis and conduction, but the measurements of the mass and the electric charge of the radiant particles of the cathode rays by J. J. Thomson were the first great incentive to the concentration of research on this interesting subject. Chemical affinity is now explained by the electronic theory, the electrons being according to this theory the chemical bonds which tie together the atoms into the compound molecule. The electrification of bodies by friction is merely the rubbing-off of the superficial layer of electrons. Conduction is a flow of electrons through the atomic interspaces of the conductor, the atoms of which have a loose attachment to the electron. Dielectric strain is a displacement of the electron from its position of stable equilibrium on the atoms of the insulator, the atoms of which have a very strong attachment to the electron. Electrolysis, voltaic action, thermo-electricity have all received more complete explanations by means of the electronic theory than they received in terms of the older theories, and new phenomena have already been discovered under the guidance of the new theory. The mysterious Becquerel rays are now generally looked upon as a volcanic eruption of electrons freed by some unknown force from the weak grasp of the atoms of radio-active substances. Elster and Geitel have actually made the surface of an aluminium wire radio-active by charging it for several hours to a negative potential by an electric machine. The ultimate nature of the electron and its relation to the ether is a much more difficult subject, and the key which will unlock this secret of nature does not yet appear to have been found. Prof. Fleming refers to the views of Dr. Larmor, which are described in his book on "Ether and Matter." Larmor starts with the assumption of an ether which is a frictionless fluid, but possesses the property of inertia. He regards the electron as a strain centre in the ether—that is, a locality from which ether strain radiates. Electrons are positive or negative according to the direction of the strain, and the theory requires that to every positive electron there should be a corresponding negative one. Atoms, according to Larmor, are collocations of electrons in stable orbital motion, like star clusters or systems. Mr. Jeans has raised a serious objection to this view by showing that an infinite number of vibrations of the electrons about each state of steady motion would be possible, and that consequently the spectrum of a gas would be continuous, and not a bright line spectrum. In order to get a stable structure, Mr. Jeans has to assume that the electrons, whether similar or dissimilar, all repel each other at very small distances—an assumption which appears to be an outrage on the simplicity of the laws of nature. All these theories also fail to account for the force of gravitation. Hence we need, as Prof. Fleming remarks, a "second Newton, who shall formulate for us the true law of action of these electrons, which form the foundation stones of the material universe."

Aberdeen.—The financial year of the Corporation Tramways just closed shows that the total receipts for the 12 months amounted to about £37,000—an increase of nearly £2,225 over the returns for the preceding year.

THE BORDIGHERA—VENTIMIGLIA ELECTRIC TRAMWAY.

The electric tramway service between the towns of Bordighera and Ventimiglia, on the Italian Riviera, was opened to the public on December 30th, 1901. The line is the property of the Woodhouse & Baillie Riviera Electricity Company, Limited, which company also supplies light and power to the two towns named. The concession for the tramway is

Fig. 1.—View of Tramway at Ventimiglia.

Fig. 2.—View of Car Shed.

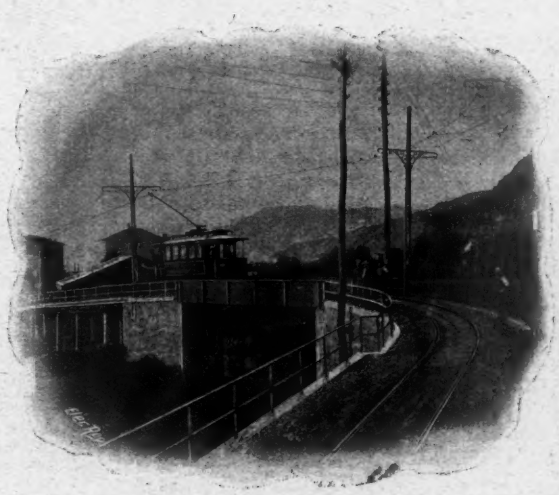


Fig. 3.—View of Bridge Over Railway.

held for a term of 50 years, and was granted by the Province of Porto Maurizio, being confirmed by Royal decree.

The concession was originally granted to Messrs. Woodhouse & Baillie in the year 1898, but the Mediterranean Railway Company opposed the project, and succeeded in causing a delay of a couple of years in the carrying out of the undertaking. The Mediterranean Railway cuts across the Provincial Road at a level crossing about half-way between Ventimiglia and Bordighera, and the consent of the railway company to the crossing of the tramway was necessary before the Government could authorise the construction of the line. The railway company at first refused to consider any proposal from the concessionaires for crossing either above or below their line, and it was not until influential pressure had been brought to bear that the company was at last compelled to come to some arrangement.

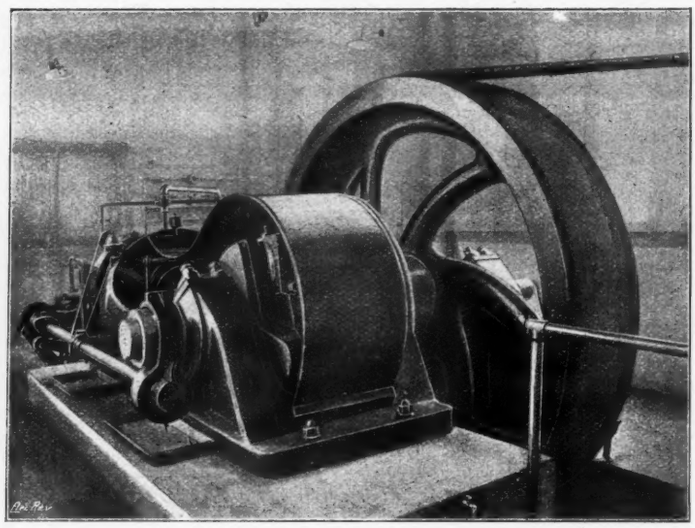


FIG. 4.—90-H.P. STOCKPORT GAS ENGINE AT VENTIMIGLIA GENERATING STATION.

The plan finally decided upon was to make a bridge over the railway line a little to the west of the level crossing. The bridge is constructed of iron girders resting on masonry, and the approach from the west is partly by means of a viaduct made in "ciment armée," and consisting of seven spans having a length of 5 metres each. It is interesting to note that this viaduct gave most excellent results during the official tests. Each span was loaded with 32 tons of sacks of earth, and under this load the deflection of the central point was in no case more than 0 25 mm. When a loaded car weighing 12 tons passed up and down, no deflection at all could be observed.

The power for the tramways is supplied from the company's power house, situated in Ventimiglia, and distant some 700 metres from the end of the tramline in that town. The length of the line, which is single, is 5,750 metres. There are three turn-outs and double lines at the ends. Four cars are able to run a 15-minute service. The car sheds are situated not far from the middle of the line, and in close proximity to the bridge over the railway. A battery of Tudor accumulators has also been placed here, which, working in parallel with the dynamo at the power house, takes the peaks of the load. The position of the battery near the centre of the line helps to equalise the pressure, and tends to diminish electrolytic effects.

The trolley wire is of 9 mm. diameter, and no feeder is required. Power for the tramway is supplied by two dynamos of Messrs. Alioth's make, each rated at 85 amperes at 650 volts. One of these machines is working and the other spare. They can be operated either by water-power or by gas engines.

The central station contains two turbines of 75 H.P. each, and two gas engines of 90 H.P. each, with Dowson gas plant of 300 H.P. One of the engines is by Crossley Bros., and the other is a Stockport engine by Messrs. J. E. H. Andrew and Co. Current is generated normally at a pressure of 600 volts, the pressure at the battery being thereby maintained at 550 volts. The battery is of the Tudor Company's well-known propulsion type, and has a capacity of 128 amperes for one hour.

The tramcars are of the type common in Genoa and Milan. They have a seating capacity for 18, and standing room on the two platforms for 12 additional passengers. They were constructed by Messrs. Diatto, of Turin, the electrical equipment being by Messrs. Alioth, and consisting of two motors of 20 H.P. each.

The line is level and straight for almost its entire length. The maximum incline is 5 per cent. at the approach to the bridge over the railway.

During the first three months of operation some 120,000 passengers have been carried. The line is being much patronised by English visitors to Bordighera, although the greater part of the traffic is native.

Messrs. Woodhouse & Baillie hold the concessions for the extension of the present line towards the east to San Remo, and towards the west to Mentone, and these extensions will be made when the projected works for the development of additional water-power have been completed.

Tipton.—The Electric Construction Company, of Wolverhampton, has recently completed an important electric power installation at the Horseley Company's Works, Tipton. The greater portion of the motors are some considerable distance from the power house, and a 500-volt system is employed. The generating plant consists of an E.C.C. standard compound-wound dynamo of 105 H.P. capacity, driven by a Stockport gas engine. As regards the various motors installed, these are employed in driving line shafting in the several fitting shops, hydraulic pumps, large shears, and large plate planing machines, &c. In addition to these, several jib cranes, formerly steam driven, are being equipped for electric driving.

FIG. 5.—DOWSON GAS PLANT AT VENTIMIGLIA GENERATING STATION.

HARISON AUTOMATIC SIGNALS.

This system of signalling, which has been installed on the Portsmouth Corporation Tramways, has now been at work for a considerable time with excellent results. The services of two signalmen, at the portion of the line shown in the illustrations below, have been dispensed with, thereby making a considerable saving, and it is proposed to instal the system at other points on the line where there are dangerous curves.

The system is carried out as follows :—

At each end of a portion of line on which it is not possible or desirable for two cars to meet or pass each other, a signal is erected; this can be attached to the tramway pole or other suitable support. It is provided with the usual semaphore arm and spectacles, the light for the latter being provided by incandescent lamps enclosed in the drum. On a car approaching the signal, having stopped at a point determined, the motorman puts on his controller to start the car; if the line is clear the semaphore arm of the signal in front of him will be lowered, showing a green light at night, and at the same time the signal at the far end is locked in a horizontal position, showing a red light at night and indicating that the line is not clear. The arms are counter-weighted so that they automatically return to the danger position, as required by the Board of Trade.

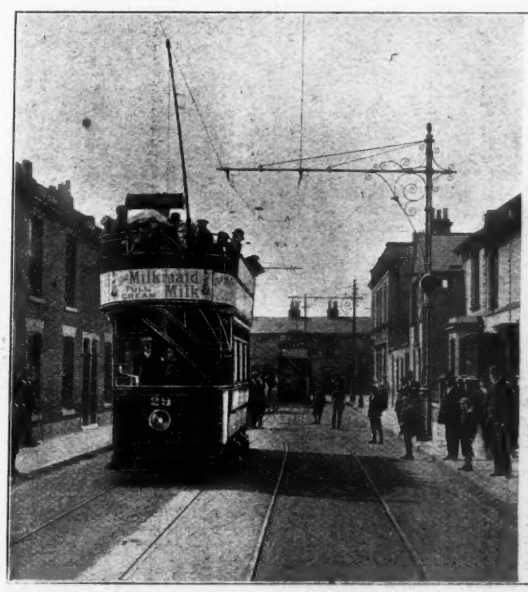


Fig. 1.—Line Blocked by Approaching Car.

Fig. 2.—Line Clear.

Harison Automatic Signal.

Having lowered the arm (if the line is clear), the car passes on its way over the protected portion of track, at the end of which, having stopped (if a stop is necessary), the motorman again puts on his controller to proceed on his way, and by this action unlocks the signal at this end.

The system is also arranged to be worked as a "lock-and-block" system, that is, allowing only one car to be on the protected portion of the line at one time, whereas on the ordinary "lock" system one car is allowed to follow another in the same direction. The possibility of two cars reaching opposite ends of the section of line to be protected at the same moment, putting on their controllers at exactly the same instant, and locking the two signals in the danger position, has been provided against by arranging the mechanism of one signal so that the car at this end prevents the other from locking the signal.

Fig. 2 illustrates the car passing on its way, having lowered its signal. Fig. 1 illustrates a car waiting, having been stopped by the signal, which has been locked at danger by the car seen approaching around the corner. The system can be arranged to protect any length of line, either double or single, with double or single conductors, be they overhead double or single trolleys, conduit, third rail, or other systems. The installation is easily made, in fact, in Portsmouth it was carried out without interruption to the service.

Not only as a labour-saving device, but also as regards reliability of working and saving of time, this should prove of value, both on surface tramways and on underground railways where trains follow one another in quick succession. There are no movable electrical connections to wear, spark, or get out of order. The system is the invention of Mr. T. Harison Jones, late of Toronto, who has had several years' experience in electrical engineering in America.

M. HOSPITALIER'S ONDOGRAPH.

The ondograph is an apparatus which registers direct in ink on a strip of paper, with respect to time, the curves representing periodically and rapidly changing phenomena (electromotive force, current, difference of potential, power, &c.). It is based in principle on a combination of M. Joubert's method of successive points, of the stroboscopic method, and of electrical registering apparatus.

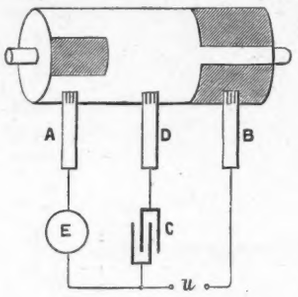
It is composed of the following :—

1. Of a synchronous alternating current motor worked direct, or after suitable transformation, by the electrical source of whose periodical varia' ns it is desired to obtain the record.

2. Of an arrangement of gearing which imparts to a revolving commutator an angular velocity such that, while the motor effects a certain number of revolutions, the commutator effects an equal number (or a multiple) augmented or diminished by 1. It is preferable for the commutator to turn less quickly than the motor, so that the record of the curve may be traced in the same direction as the time co-ordinate. This delay or advance, essential to the system, avoids the necessity of imparting an actual rotation to the motor brushes.

3. Of an automatic commutator formed of a cylindrical core of insulating material, carrying a brass tube suitably divided, against which three brushes bear. This arrangement places a condenser successively in connection with (*a*) two points of the circuit in which the periodically variable phenomena to be registered occur, (*b*) a measuring apparatus. In the first operation the condenser is charged; it

discharges itself to the measuring apparatus in the second operation. For tracing power curves, the commutator is reduced to a simple conducting bar periodically closing the circuit of the fine wire bobbin of the registering apparatus



A, B, D, Brushes; C, Condenser of variable capacity; E, Registering apparatus; u, Points for applying the periodic difference of potential to be registered.

Fig. 1.—Connections of the Ondograph when a Condenser is Used.

once each revolution by the intermediary of two brushes. Fig. 1 shows the connections of the apparatus in a case where a condenser is used.

4. Of a condenser whose capacity can be varied at will, in order to regulate the sensibility of the apparatus.

5. Of a measuring apparatus suitable to the phenomenon to be registered.

For differences of potential and currents, the registering apparatus has a movable coil placed either horizontally or vertically.

For power, the registering apparatus is an ordinary wattmeter; the alternating current traverses the stationary coil, while the movable coil of fine wire is placed in the circuit periodically closed by the revolving coupler on the difference of potential determining the second factor of the power. It is regulated by the introduction of resistances into the fine wire circuit.

The direct method can also be applied to recording differences of potential and currents; this dispenses with the use of the condenser, but the condenser presents certain practical advantages for regulation and sensibility. The wattmeter also allows of the registering of curves of difference of potential, by causing its fixed coils to be traversed by a steady current supplied by a battery of accumulators. In each case the movable coil of the registering apparatus receives a series of impulses whose frequency is equal to that of the current to be registered. It possesses inertia and damping calculated so that the position of the movable coil corresponds at each moment with that which the mean current would make it take, corresponding with the quantity of electricity which traverses it during one period.

6. Of a cylindrical or uninterrupted registering apparatus driven at a suitable speed by the synchronous motor. The registering apparatus may be anything — pen, wheel, sensitised paper, smoked paper, &c. The paper can be mounted on a revolving cylinder, winding itself off on rollers, or passing off longitudinally in the direction of the generatrices of a cylinder coaxial with the measuring apparatus, and having a radius equal to the distance of the pen from the axis.

In the model represented in fig. 2, and constructed by the Cie. pour la Fabrication des Compteurs, the synchronous motor consists of a cross of soft laminated iron moving between the arms of a U-shaped electro-magnet, whose yoke carries a winding traversed by a part of the alternating current to be studied. This motor absorbs from 0·2 to 0·3 ampere at 110 volts with a very low power factor.

The motor is attached to the shaft by a device which allows it to attain the angular velocity corresponding with synchronism.

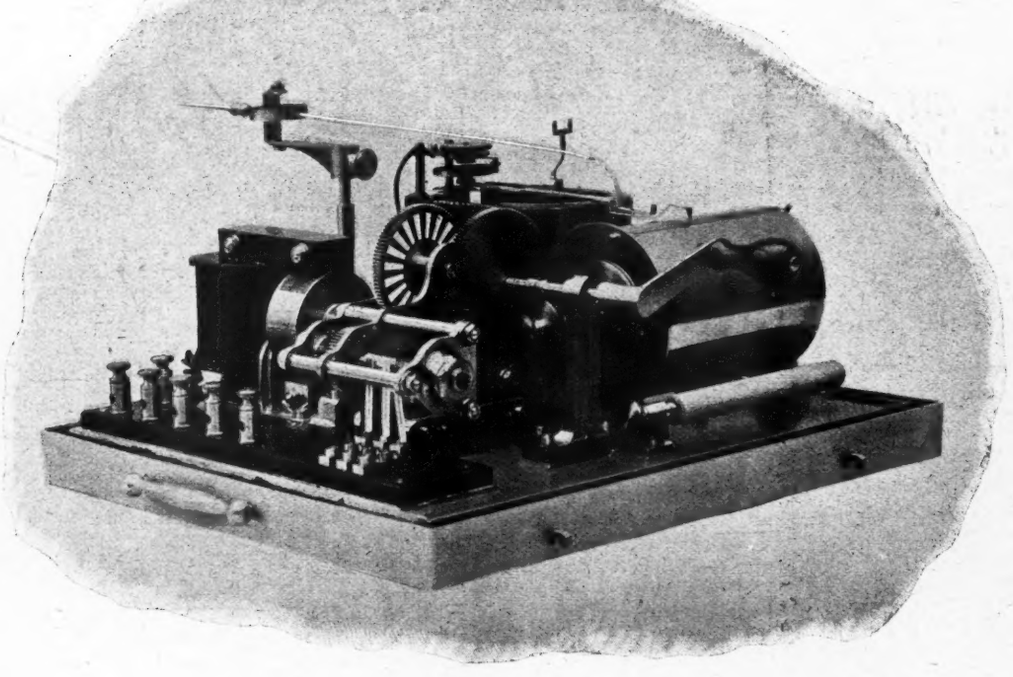


Fig. 2.—M. Hospitalier's Ondograph.

It is seen that this is attained by observing the stroboscopic effect of rest, apparent on a disc bearing a suitable number of alternate black and white sections. After synchronising, the crankshaft disengages itself automatically by a device similar to that in use on automobiles.

The motor drives the commutator by a convenient system of gearing, so arranged that when the motor has made n turns, corresponding to n periods, the commutator has made $(n - 1)$ turns only, with a uniform slip. The

commutator, mounted on an ebonite cylinder, presents no special features, any more than the three brushes which are applied to it.

The gearing is arranged in such a manner that the retardation may be $\frac{1}{1000}$, that is to say, that the alternating wave is recorded in an interval of time 1,000 times longer than its duration, say, 25 seconds, for example, for an alternating current of frequency, 40.

The condenser may be of any type, paraffined paper or mica, and its capacity need not be known exactly; it is sufficient for it to remain constant during an experiment.

The registering apparatus is of M. Meylan's well-known magnetic type, but the control of the pen is effected by a new and interesting device, which could be applied to the registering apparatus of any other system. With most of the registering apparatus used for direct tracing, the length of the needle controlling the pen has to be reduced, so that the friction of the pen against the paper shall not prevent a correct record being made. The use of a short needle controlling the pen in the ordinary way, necessitated by the weakness of the controlling couple and the friction of the pen, has several disadvantages:—

1. The curvilinear ordinates have a radius of curvature relatively small, and the curve registered undergoes, from this fact, a distortion often embarrassing.

2. The curvilinear path described by the pen prevents it from bearing exactly on all points of the registering cylinder, of which it would describe a generatrix if the radius were infinite. Under these conditions a well-adjusted pen records by dots in certain parts, bears strongly on the paper in other parts, and does not bear at all on the parts corresponding to the longest ordinates.

3. The stem bearing the pen should be at the same time *rigid* for the line of direction, and *flexible* for the record; it is difficult to unite in one instrument these two contradictory qualities.

To reduce these inconveniences in great measure, we employ a device which consists in principle in separating the directing part from the recording part, and in realising with a controlling system of small radius, a registration of which the ordinates have a radius large enough for the record to sensibly approach that which a registering apparatus would give whose pen would describe an arc of infinite radius.

The registering apparatus is composed of two distinct parts, the controlling needle and the recording pen.

The controlling needle is a rigid lever mounted on the measuring apparatus, of which the extremity furthest from the axis of rotation terminates in a stem which engages the lever bearing the pen.

This stem describes during the registering the path which the pen of the ordinary registering apparatus would describe during the rotation of the cylinder bearing the paper.

The recording pen consists of a lever of great length, one of whose extremities turns on a pivot round a vertical axis parallel to that of the registering apparatus, but is removed from it to a distance sensibly equal to the difference between the lengths of the two levers. Its other extremity terminates in a slot in which moves the vertical stem of the controlling needle, and carries the recording pen.

Under these conditions, while the stem describes an arc of small radius, the pen describes an arc of large radius; by giving sufficient length to the lever which bears it, this arc can, within the limits of the breadth of the cylinder, coincide with the tangent at its middle.

The line of contact of the pen with the paper is thus very little removed from a generatrix, and the record is made with perfect equality on all parts of the cylinder. The pen and its lever then can be proportioned to satisfy the conditions of flexibility and of the adjustment of the record, and of the record alone, since the direction of the pen is entrusted to another organ to which is given all the necessary rigidity for exactly fulfilling its duty of directing the pen. The directing lever and the recording lever describe arcs of different radii, and it follows that the directing lever glides easily with a backward and forward movement in the groove on the lever bearing the pen.

The lever carrying the pen is articulated to its position by a Cardew joint, which allows the pen to be freely moved and to exercise on the paper a constant pressure regulated by its own weight, partly balanced by an adjustable counter-weight. The vertical axis allows of deviations in the line of direction; the horizontal axis, the slight deviation in height made by the moving of the pen on the registering cylinder.

Thanks to these arrangements, the record of the curve is made almost exactly on the generatrix of the registering cylinder, and the pen, more independent and more easily regulated, no longer fails to make proper records.

The device can be used with advantage in every case where the lengthening of the apparatus resulting from the use of a longer needle does not constitute a serious objection to its use.

(To be concluded.)

PARLIAMENTARY.

Lord Windsor's Tube Committee.

At the sitting of this Committee on Wednesday last week counsel representing the proposed Brompton and Piccadilly Circus and the Piccadilly and City Railways agreed to accept a clause providing that where two tubes run in close proximity under the same road an owner should be entitled to claim against the two companies. The claim was then to be sent to an arbitrator, who should decide as to which of the companies should pay whatever compensation he might award. This clause is in pursuance of the principle already laid down by the Committee for the protection of owners.

Mr. Shiress Will, K.C., asked for a special clause for the protection of the Adelphi and Vaudeville Theatres, giving the owners of those theatres power to appoint an engineer to inspect the work during the construction of the line.

The Committee assented to such a clause being inserted.

Mr. Littler, K.C., next submitted a clause on behalf of the Halls of the Middle and Inner Temples, the Temple Church and the Master's House, which contained the following sub-sections:—"The company shall pay to the societies compensation for all damage and injury of every description which may arise to the societies' special buildings by or from the construction or working of the railway." Mr. Littler said that the promoters objected to that part of the clause, but he hoped that the Committee would see their way to put that obligation upon them in view of the exceptional nature of the Temple buildings. A time clause, he submitted, would not meet the justice of the case.

The Chairman said the Committee would pass the clause, but its operation would be limited to five years, to date from the opening of the line.

Mr. Littler then asked for a special clause on behalf of the City Corporation in respect to the proposed station under Cannon Street. He said that the Corporation owned the subsoil of Cannon Street, which they had acquired at very great expense, and the case was altogether an exceptional one.

After hearing the evidence in support of the clause, the Committee rejected it, but they passed another clause submitted by the Corporation which had for its object to prevent the contractors of the railways from using carts in carrying away the materials which would let it fall on to the pavement. The clause provided further, that in the event of default in this respect the City Commissioner of Police should be at liberty to seize the vehicle and horses, and on the facts being proved, a Court of Summary Jurisdiction might order the cart and horses to be sold and the proceeds of the sale to go to the Police Superannuation Fund.

Mr. Shiress Will said that, for the protection of the Albert Hall, a clause had been agreed on with the promoters of the London Electric Railways Bill, but in view of the national character of the building, he asked for a further clause imposing on the company liability in perpetuity.

Mr. Coward, K.C., said that the tube would be quite 130 ft. away from the Albert Hall, and he asked the Committee to say that ample protection was already afforded by the special clause agreed upon.

The Chairman said that was the view of the Committee, and therefore they could not accede to Mr. Shiress Will's request for a clause imposing unlimited liability on the company.

An application by Lord R. Cecil for a special clause in the case of the Phillimore estate in High Street, Kensington, was refused on the ground that ample protection was afforded by the general law.

This Committee concluded its labours on Thursday of last week by considering clauses proposed for insertion in the Brompton and Piccadilly Circus, the London United Electric, the Piccadilly and City and the North-East London Railway Bills.

The London County Council sought to obtain a clause for the protection of the Shaftesbury Drinking Fountain in Piccadilly Circus, and after some discussion it was granted subject to the insertion of the following words: "but the company may construct their railway thereunder."

Mr. Coward, K.C., next applied on behalf of the County Council for a special clause dealing with workmen's fares, which should include the whole of the Brompton and Piccadilly and the Great Northern and Strand Railways. He said that the clause was in operation on the Central London Railway, and if it were not inserted there would be three different sets of workmen's fares over three different sets of line.

Mr. LITTLER, K.C., asked the Committee not to impose the clause upon the companies, and pointed out that a similar clause had been twice rejected in the case of the Great Northern and Strand Bill.

The Committee refused to allow the clause, but they consented to a clause giving the proprietors of the London Hippodrome power to appoint, at their own expense, an engineer to inspect the line during the course of construction.

Mr. PEMBER, K.C., applied on behalf of the London County Council for the addition of a clause in the Bill providing that under no circumstances should any interference be ordered by any arbitrator with the gradients or positions of the main or branch sewers of London.

Mr. MOON, K.C., asked the Committee to leave that question to be settled by the arbitrator and not to make any hard and-fast rule.

Mr. LITTLER followed on the same lines, and said that if such a provision were made absolute it might result in stopping the construction of some of the proposed lines.

The CHAIRMAN said the Committee could not see their way to allow the clause. A number of other clauses were attempted to be obtained by the County Council, but most of them were rejected, Lord KNUTSFORD observing that if the Committee had given the County Council all the powers they asked for it would have amounted to making that body the managers of the company's affairs.

The Bills were then ordered to be reported to the House for third reading.

LONDON UNITED TRAMWAYS.

THE Select Committee of the House of Commons, presided over by Mr. Compton Rickett, on Wednesday last week, resumed the consideration of this Bill.

Mr. FITZGERALD, K.C., read a letter from the Thames Conservancy, approving of the plans of the promoters for the construction of the embankment along the river front at Barnes, involving the taking of a certain portion of the foreshore.

Lord R. CECIL, K.C., on behalf of various frontagers, said the Conservators had no power to authorise the construction of an embankment without Parliamentary powers. It was decided to postpone the matter for further consideration.

Mr. Councillor W. THOMPSON, of the Tramways Committee of the Richmond Town Council, gave evidence in support of the Bill, and said that special knowledge of the district to be traversed by the proposed line, led him to think that the present railway fares were too high, and the arrangements were wholly inadequate for workmen.

Mr. H. J. BARTON, chairman of the Highways Committee of the Barnes Council, said his Council supported the tramway from Richmond, through Barnes to Hammersmith, chiefly for the benefit of Mortlake, which had no other communication than the London and South-Western Railway. The residents in the district were strongly in favour of the proposed line. Other local evidence having been heard,

The CHAIRMAN said a communication had been received from the Local Government Board to the effect that the Committee should advise themselves as to the application of the money to be paid by the Tramway Company under agreements with local authorities. The Committee adjourned.

A large portion of the sitting of the Select Committee on Thursday last week was devoted to frontagers' objections with regard to the proposal of the promoters to construct an embankment of the river at Barnes Terrace. The sitting was adjourned.

The Acton Urban District Council has withdrawn its opposition to the London United Tramways Bill.

The whole of the evidence given on Monday at the resumed sitting of the Select Committee inquiring into the London United Tramway Bill was of a local character, dealing principally with the proposed tramways in the Wimbledon District.

Replying to the CHAIRMAN, Mr. BALFOUR BROWNE, K.C., said the promoters would be willing to lay down a length of about 300 yards to connect their proposed No. 13 line with the L.C.C. Tramway at Tooting.

Mr. TALBOT said he would communicate the fact to the London County Council as the suggested line came within the London County area. The Committee adjourned.

TYNESIDE TRAMWAYS.

ON 6th inst. the Court of Referees considered the application of the North-Eastern Railway Company for a *locus standi* against the Tyneside Tramways Bill. The grounds upon which the application was based were those of competition and interference with works. It was argued that the company were entitled to be heard with respect to the protection of their bridges. The Court disallowed the application.

New Committee.—Lords Brougham and Vaux, Romney, North, Colchester and Manchester, have been appointed a Select Committee of the House of Lords to consider a new grout of Bills which includes the Kent Electric Power Bill, the South Wales Electrical Power Distribution Bill, the Southport and Lytham Tramway Bill and the Salford Corporation Bill.

Scarborough Tramways.—This Bill has been ordered to be reported to the House of Lords for third reading.

Preston Corporation Tramways.—On Thursday last week this Bill was before Lord Morley's Committee of the House of Lords on Unopposed Bills, and was advanced a further stage.

Gloucestershire Electric Power Bill.—This Bill was before Lord Morley's Committee of the House of Lords on Unopposed Bills on Thursday last week, and the necessary proof having been given, was ordered to be reported to the House for third reading.

Dartford Improvement Bill.—This Bill was carried a further stage last week when it was before Lord Morley's Unopposed Committee of the House of Lords, and was ordered to be reported to the House.

Pontypridd Urban District Council Tramways.—The Taff Vale Railway Company and a number of frontagers have given notice of their intention to oppose the confirmation of the tramway order to the Pontypridd Urban District Council, which is amongst the others in the Tramways Orders Confirmation Bill (No. 2).

Heywood Corporation Tramways.—A petition against the confirmation of this order, contained in Tramways Orders Confirmation (No. 2) Bill has been deposited by the Lancashire and Yorkshire Railway Company.

North Metropolitan Tramways.—The Tottenham Urban District Council and the Middlesex County Council are each opposing this Bill.

Garston and District Tramways and Elertric Supply (Transfer).—The U.D.C. have deposited a petition asking to be heard against this Bill, which transfers the powers of the Tramways and Electric Lighting Companies to the Liverpool Corporation.

Dumbarton Electric Lighting.—Petitions have been deposited in the Private Bill Office of the House of Lords by the North British Railway Company, the Dumbarton and Ballock Joint Line Committee and the Lanarkshire & Dumbartonshire Railway Company against the provisional order granted to Dumbarton in the Electric Lighting Provisional Orders (No. 5) Bill.

The North Metropolitan Electric Power Supply Company, Limited, have deposited a petition in the Private Bill Office of the House of Lords praying to be heard in opposition to the Electric Lighting Orders Confirmation Bill No. 1. The orders granted under the Bill are to the local authorities of Edmonton, Tottenham, and Wood Green.

Standing Order Proofs.—The following Bills were before the Examiner of Standing Orders in the House of Lords last week and were found to have complied with Standing Orders:—Electric Light Provisional Orders Bills Nos 1, 4, 7 and 8; North Metropolitan Tramways, York Corporation Bill, and Tramways Orders Confirmation Bill (No. 1). In the case of the Whitechapel and Bow Railway Bill, Standing Orders were found not to have been complied with, and the Bill will accordingly have to go before Standing Orders Committee.

LEGAL.

ACTION AGAINST THE SOUTHWARK BOROUGH COUNCIL.

AT the Southwark County Court on Monday, his Honour Judge Addison, K.C., and a jury, heard a claim by a married woman, named Ruler, against the Southwark Borough Council, for damages for personal injuries sustained by her, and caused by an explosion alleged to have been brought about "owing to the negligence of the defendants in controlling certain electric wires and cables." Mr. Drury appeared for the plaintiff, and Mr. Frank Dodd for the defendants. The plaintiff's case was that on the night of April 1st, she was at the corner of Long Lane, Borough, when an explosion occurred in one of the electric light manholes close by. The iron-bound granite top was blown off and over the railings of a public lavatory, and she was taken off her feet and fell to the ground. She endeavoured to rise but fell again, and remembered no more until she found herself home and in bed. A doctor was called to her, and he had continued to attend her down to the present time. She still felt the results of the shock, which, according to her medical attendant, Dr. Burke, consisted of attacks of giddiness, fainting fits, confusion of thought—a complaint, his Honour remarked, from which many persons suffered without receiving electric shocks—sleeplessness, flushes of the head, increasing dimness of vision, inability to read as well as she used to, noises in her ears, trembling, inability to hold things in the right hand for any length of time, "pins and needles" in her extremities, loss of flesh, a careworn appearance, abnormal reflexes and twitching of the lips and tongue, &c. He had seen no improvement in her condition since he had been attending her, and he could not predict the result of all the symptoms. All were the result of a severe shock, and there was no sign of bruising.

Police-Constable RICHARD LOCK, called by the plaintiff, said he was on duty near the manhole when all the lights went out; he heard an explosion, felt a shock go through him, saw the cover fly over into the lavatory, and a column of smoke and flame come from the hole. He immediately looked round to see if anybody had been injured, but did not see any sign of it, and then ran and pulled the fire alarm. Chief Inspector Bonner and 40 constables were upon the scene in a few minutes, but no case of injury was reported as resulting from the explosion. Had the plaintiff fallen as described, he would have been bound to have seen her.

No witnesses were called to speak to taking the plaintiff home, and at the conclusion of the evidence on her behalf, Mr. Dodd submitted that no case had been made out, as no negligence had been shown.

His HONOUR said the highway was a very sacred place, and the fact that there was an explosion and the plaintiff swore that she was thrown down, placed upon the defendants the onus of proving

that they had taken every precaution that skill and extreme care could suggest to prevent such an occurrence, and therefore the case must go to the jury.

Chief Inspector BONNER, called by the defendants, gave similar evidence to that of P.C. Lock.

The point as to the cause of the explosion was suggested, but his HONOUR remarked that Mr. Dodd had better not burden the case with it, as it was a matter of extreme difficulty which puzzled scientific men. But he could not help thinking that such an explosion could not occur without blame being somewhere.

Mr. DODD said he agreed with his Honour as to the difficulty of persuading people that the accident could not have been prevented.

His HONOUR: Those who are given the power to put electric cables under our streets ought to do it in such a way that these things won't occur, but if they do occur after everything human skill can do has been done to prevent them, then they are not liable. But the great difficulty is to prove that, and it would necessitate a long and costly inquiry, which I do not think you would be wise to enter upon in this case.

In the end the case went to the jury on the question as to whether the plaintiff had made out her case as to the accident occurring. After a hearing which lasted nearly the whole day, the jury found for the defendants, and judgment was entered for them with costs.

THE INQUIRY INTO THE MANAGEMENT OF THE SALFORD ELECTRICITY UNDERTAKING.

(*Concluded from page* 950.)

JUDGE PARRY continued his inquiry into this matter on Wednesday, Friday and Saturday last week, and the following is an abstract of the proceedings as obtained from the *Manchester Courier* report:—

Mr. F. W. Wheatcroft dissociated himself and Mr. Turner from any charges against Aldermen Shaw and Holland. He then continued his statement with a view to showing that undue influence had been exercised upon some of the Committee and the consulting engineers. He complained that the engineers first reported that the Corliss engines would not run satisfactorily at 100 revolutions a minute, and then that they would. When the Commiteee met to consider the question of the engines, he suggested that Sir Richard Mottram should leave the room whilst Mr. Clirehugh reported. He alleged that Sir Richard declined. In the event the tender of Messrs. Mather & Platt was accepted. [By His Honour: Galloways had nothing to do with the engines.] On the day the tenders for the boilers for the Strawberry Road works were to be opened by the Committee he met the chairman, Mr. Howarth, and the latter said he had been to Galloways to ask them to tender and he hoped witness would use his influence in favour of their tender. At the meeting the Committee deferred the acceptance of a tender. He did not attend another meeting, and subsequently the tender of Messrs. Galloways, Limited, for £15,200, was accepted by the Council by 35 votes to 4, though it was not the lowest tender. As a matter of principle, seeing that the consulting engineers had scheduled three names—Messrs. Yates & Thom, Messrs. Tinkers, and Messrs. Galloways—the contract should have gone to the lowest.

Mr. Howarth denied the accuracy of witness's statements.

His Honour said that the placing of the contract was not a matter for him to inquire into; the Council had decided it.

In reply to Mr. W. Cobbett, who appeared for Messrs. Lacey, Clirehugh & Sillar, Mr. Wheatcroft said he did not think they acted rightly in considering a letter accompanying a tender, and allowing an alteration in the price of the superheaters.

His Honour asked if he was really charging these people—a firm of repute—with fraud in the matter.

Mr. Wheatcroft said he charged them with ill-faith as advisers to the Committee.

Mr. Cobbett: That was that they were helping someone to cheat the Corporation?

Mr. Wheatcroft said they acted with ill-faith to the Committee through weakness.

His Honour said he had listened to Mr. Wheatcroft for a whole day and had every desire to assist him, but he must confess he did not follow him. Either Sir Richard Mottram, Mr. Clirehugh, and Messrs. Galloway and the chairman (Mr. Howarth) conspired together in altering tenders, or there was nothing in it at all.—Are you asking me to find that they did? If it is so, it is a very serious charge. First you say yes, and then you say no.

Mr. Galloway: It amounts to a serious charge of collusion and conspiracy.

His Honour: Or nothing at all—I have not got at it yet. Either you will take the responsibility of making the charge or you will not make it. Now is the time.

Mr. Wheatcroft replied that he was in a difficult position, with all the legal talent arrayed against him.

His Honour: Oh, answer the question, sir; yes or no?

Mr. Wheatcroft said that the consulting engineers had proved to be weak advisers of the Corporation in the matter.

His Honour: Very well, if you won't put it any further than that we will get on.

Mr. Cobbett cross-examined the witness about the document put in the previous evening, which, it is alleged, is a report of the consulting engineers', which was suppressed and an other substituted. Witness said he had the document from Mr. Turner in about March, 1901, who told him he had it from Mr. Clirehugh, and that it had been altered at someone's request, with a view to elaborating the engines. Cross-examined with regard to the Strawberry Road works witness maintained that far too much plant had been put down. He was satisfied with Mr. Turner's quantity. He was not aware that Mr. Clirehugh had advised that only half the quantity in Mr. Turner's plans should be used.

A report of Messrs. Lacey, Clirehugh & Sillar was put in to this effect.

Cross-examined by Mr. Desquesnes, on behalf of Sir Richard Mottram, witness said that it was in November, 1893, he first heard of undue influence. He repeated his charges as to Sir Richard Mottram's action on the Committee. He was not aware that several firms refused to tender because they could not tender to the specifications of Mr. Turner.

Mr. Desquesnes here handed in a letter from Mr. W. M. Mather to the effect that however satisfactory an electrical engineer they might have, yet, having regard to the extreme importance of the undertaking, Salford was really departing from the practice of other Municipal Corporations in not seeking advice from well-known authorities on such a very important matter. His firm would not tender on the specification, but, as a large ratepayer in the borough, and connected with a firm having special knowledge of such matters, he felt that he would like to confer with those who had the responsibility in the matter.

His Honour thought the letter a very proper one.

Witness did not know that Sir Richard Mottram was called into the matter by Messrs. Mather in view of the importance of the question, and thus came to give the Council the benefit of his counsel and advice. He did not know that by his advice the chairman, deputy-chairman, and Mr. Turner went to see Mr. Mather. Mr. Turner had never told him that. He was not told the story in that way by Mr. Howarth, and from what had come out now it modified his opinion of Sir Richard's action, not having been aware that he was asked to give his advice by Mr. Mather. Witness objected altogether to Sir Richard having attended the Committee when the tenders were let. He thought it unfair to the other contractors. As a matter of fact, however, Sir Richard voted for Messrs. Mather's letter.

By Mr. Dean: Mr. Howarth told witness in the train that he had seen Galloways, and asked them to tender. Witness thought, as chairman of the Committee, he should not have gone to any firm.

His Honour said if it was done he should agree with Mr. Wheatcroft that it was quite irregular for the chairman to go about asking a particular firm to tender. They would, of course, hear Mr. Howarth's evidence.

Mr. Galloway (Messrs. Payne, Galloway & Payne), who appeared for Galloways, Limited, cross-examined Mr. Wheatcroft. The latter said he did not know Mr. Norbury's position in the matter. He did not know he was a traveller securing orders, and that there was nothing improper about his seeking orders if he could get them.

Mr. Wheatcroft said he did not blame Messrs. Galloway tendering, and Mr. Norbury doing all he could to get an order. He did not suggest for a moment that Messrs. Galloway had done anything improper. They were an honourable and old-established firm. He had no complaint to make about the work, and nothing detrimental to say in any shape or form. He was sorry, in fact, their name had cropped up in the matter.

His Honour said Mr. Wheatcroft had no charge against the firm, as he had fairly said. There was nothing to be said further in the matter. Mr. Galloway might now withdraw, because there was nothing for him to answer.

Mr. Turner, the ex-electrical engineer, then gave evidence as to the alleged excessive expenditure on the Strawberry Road works, and had not concluded when the inquiry was adjourned until Friday.

On Thursday his Honour visited the works at Walness Road and Strawberry Road, in connection with which it was maintained by Mr. Turner, Councillor Wheatcroft, and Mr. Hunt (elective auditor) that the installation is excessive and extravagant.

Mr. Turner criticised the action of the Corporation in fixing their works at such an unsuitable place as Walness Road. As to the new station at Strawberry Road, he maintained that there had not been work enough to occupy more than one engine out of the eight put down. The maximum output during work did not exceed 1,000 KW., whereas the power installed in the station was 6,400 KW. He submitted that the station at the present time was considerably in excess of the requirements of the Corporation. They only required to-day 1,400 H.P., and had put down 10,200 H.P. He argued that 3½ times more plant than was required had been put down. The excess was rather in connection with the lighting installation than in connection with the power for the tramways. He produced a report of Mr. Clirehugh's to show that his plans were approved of, and he argued that, if his plans had been carried out, the work would have been carried out in sections as required. Mr. Turner urged that the type of engine supplied was not according to the specification. He urged that a tender of £64,000 was accepted without ever being signed by the chairman. He complained that tenders were added to the schedule that were not originally on the list, and he maintained that undue influence had been exercised to secure the placing of the contract. The witness further said that during the preparation of the specifications for boilers, Mr. Clirehugh and Sir Richard Mottram had to consult as to details, and that was on the understanding that Sir Richard's firm were not going to tender. He urged that an attempt was made to rush the tenders through without due consideration, and that very unusual practice was adopted by the chairman. When the tenders were before the Committee, witness alleged that Mr. Howarth, chairman

of the Committee, told them that Mr. Thom, of Messrs. Yates and Thom, had asked him to spend the week-end with him at Blackpool, and consequently he should not think of recommending Messrs. Yates & Thom's tender, though it was the lowest. He argued that this statement was made to damage Messrs. Yates & Thom's firm before the Committee in order to secure the acceptance of another tender. Mr. Thom denied ever having seen Mr. Howarth. Mr. Clirehugh favoured Messrs. Galloways' firm for the boilers and superheaters. Mr. Turner alleged that he was told that if he opposed Sir Richard Mottram and Mr. Clirehugh, it would be "the worse for him." He recommended the acceptance of the tender, and said that he did so through compulsion. He re-asserted that the chairman and the consulting engineers used their influence to get the contract for Messrs. Galloways, Limited. The witness argued that through the closing of the Walness Road station the ratepayers had lost from £30,000 to £40,000. On the question of sub-contracting he was not saying that the Salford Corporation had been guilty over and above other corporations, but it was a vexed question now with all municipal authorities. He thought members of the Council who were members of limited liability companies should always consider whether it was wise to do acts as members of a company which they were prevented by law from doing as individuals. His view was that shareholders of a company should, as far as possible, carry out the spirit of the Municipal Corporations Act, and take no part in the discussion or deliberations in which their firms were interested.

Mr. S. V. Clirehugh, of the firm of Messrs. Lacey, Clirehugh and Sillar, was then called by Mr. Cobbett. He said that on seeing Mr. Turner's specifications he suggested that less money should be spent in electrical plant. He was not prepared to carry out Mr. Turner's scheme at any price. They were told to provide for 300 cars, which would require 3,000 KW. That would necessitate four dynamos, and one would be required as a reserve. Very shortly other two of the dynamos would be required for purposes other than traction, and by the time of the expiration of the four years' term the remaining one would doubtless be required. They must bear in mind that running powers between Manchester and Salford were contemplated, and that they in Salford would have to draw everything Manchester liked to send on a heavy race day. He had never altered any document at the suggestion of anyone, and the document of which so much had been made was only an ordinary draft. It was not true that witness told Mr. Turner he must recommend Galloways' firm. It was also absolutely untrue that Sir Richard Mottram had endeavoured to influence him in any way. He had never been approached by Sir Richard Mottram directly or indirectly on behalf of his firm. He had never been approached by Mr. Howarth on behalf of any firm.

The witness was cross-examined at length by Mr. Wheatcroft as to his reports to the Committee, and he absolutely denied having said anything to him about Sir Richard Mottram's presence on the Committee. He denied that he consented to carry out Mr. Turner's specifications for £1,500. His firm were engaged to carry out remodelled specifications, not Mr. Turner's.

Mr. C. E. Turner cross-examined the witness. The latter said the installation at the Strawberry Road works was 6,200 KW., and the output was only 1,000 KW.

Mr. Cobbett said that really some 1,200 KW. were being used.

His Honour: The whole question was whether this was an intelligent anticipation of the public needs, or whether it was a fraudulent or wicked anticipation of the public needs. Everyone was agreed as to the amount of electricity now being used, and everyone was agreed that 6,000 KW. was going to be made. What none of them was agreed about was what would be wanted ere the next few years. That was a much more difficult thing to foresee.

Continuing, the witness said it was not true that the Corliss engine was put in on his advice. Sir Richard Mottram was deputed by the Committee to confer with him on the question of 10-ft. or 8-ft. boilers. There had been no preference or special consideration of any kind whatsoever shown to Galloways, Limited. Nothing had taken place but what was absolutely in the ordinary way of conducting business. Sir Richard Mottram never tried to use any influence to get witness's recommendation in favour of Galloways, Limited. He denied any such imputation as strongly as he possibly could. He had never been approached improperly by Mr. Howarth to secure a contract for any firm.

Mr. Desquesnes, called Sir Richard, who said he had been 24 years on the Council, and retired in November last. When Mr. Turner was electrical engineer, he sent out specifications for engines, and certain firms declined to tender. He received a message from Mr. William Mather requesting an interview. Mr. Mather said he had sent for him not only as being as engineer like himself, but as one who took great interest in the borough. He said their firm had received specifications for some engines and dynamos, which, if carried out, would be absolutely unworkable. The specifications were incomplete, and if a tender was accepted on the specifications it would open out no end of extras and so on. If they tendered to the specifications it would be totally unsatisfactory. Some of the clauses in the specification for the engine were amusing. It was stated that the engine must be made so as to pull up in one revolution if required. He should not like to be there when that took place. Witness told Mr. Mather he was in a somewhat delicate position as a member of the Council and as an engineer, and if he were to raise the question, his motives might be misinterpreted, and witness therefore asked Mr. Mather to communicate with the Mayor. That was the only interview he had, and he washed his hands of the whole affair. As a result of Mr. Mather's advice new specifications were sent out. Mr. Wheatcroft did call upon him to retire from the Council meeting. The question of the boilers had been referred to Mr. Clirehugh and himself, and he attended the committee meeting to report upon the boilers. Mr. Wheatcroft was very vexed and in a perfect fury, and most rude to witness. He believed a 10-ft. boiler was absurd. The original type of boiler had never been departed from. Mr. Turner's specification was for a Lancashire boiler, and one was working there to-day. Eventually Messrs. Galloways got the tender, but he was quite under the impression all along that they were not going to tender. He never influenced anyone in the matter at all, and knew nothing about the placing of the contract.

He never interfered in the matter of the boilers at all. He practically abandoned the whole thing lest his conduct should be misconstrued. He never took part in any meetings of directors in connection with the supply of the boilers. There was nothing in the report of the Council proceedings to show that he gave the advice he had said, but he certainly did advise the Committee. Expert opinion also condemned 10-ft. boilers.

Mr. Arthur Howarth, late chairman of the Electricity Committee, was next called, and denied all the statements alleged to have been made by him, especially with regard to the "corridor" interview, at which Mr. Wheatcroft alleged that witness told Mr. Turner it would be better for him to keep his tongue still. He was never invited by Mr. Thom to spend the week end with him at Blackpool. He was pestered by the men being first taken off one job and then another, but not by any firm to secure an order.

Mr. Turner now said he wished to be represented by counsel, and suggested that the question of his dismissal be taken at some future date. He suggested the Council acted very improperly in the matter of his dismissal.

After an interval for luncheon, his Honour said he had considered the question as to taking the evidence of Mr. Turner as to his dismissal, and said it appeared to him he ought not to inquire into it unless there were some new facts put forward, nor ought he to inquire into it unless it was relevant to that commission. His Honour's view at present was that it was not within the scope of that inquiry. Mr. Turner had mentioned Mr. Sutton's name as a legal gentlemen whose advice he desired to take. His Honour understood Mr. Turner wished to appear by counsel, and after thinking the matter over he had come to the conclusion that it would be best for Mr. Turner to take Mr. Sutton's advice. If in his opinion there were fresh facts in connection with his dismissal that ought to be considered that were not before the Committee that reported on the matter, and if Mr. Sutton was also of opinion that those facts were relevant to the terms of the inquiry, and if within 14 days that opinion was sent in to him, then he would not shut it out, but would hold a special day's hearing or as many as were necessary. Seeing that the matter had been before seven or eight gentlemen of the Corporation, his view was very strongly at present that it was a thing apart from the inquiry altogether.

Mr. Wheatcroft next gave evidence on Messrs. W. T. Glover's cable contract. He objected that theirs was not the lowest tender, and he asserted that Messrs. Lacey, Clirehugh & Sillar's report to the Committee distinctly favoured Messrs. Glover's as against the lowest tender. He asserted that the contract was not carried out according to the specification. He had no charge at all to make against Messrs. Glover as to their getting the contract.

His Honour: It is important that that should be understood.

The witness alleged that the consulting engineers allowed porous brick channelling to be used for the cable and not U-shaped stoneware non-porous troughs, as specified in the terms of the contract. He also maintained that the best bitumen had not been used, as was stipulated.

Mr. A. E. Turner, managing engineer to Messrs. Glovers, said he recommended the change of channels because he found in practice the earthenware three-way channel was the best. They made a special cover for the channels. The consulting engineer had powers under the specifications to vary the contact.

Mr. Hunt complained that Messrs. Galloways had departed from the specifications in supplying the boilers and the fittings.

Mr. Galloway admitted that Messrs. Galloways, Limited, used by inadvertence Harrison's steel alloy on the valves and mudholes instead of Siemens' steel, but they had altered all the boilers except the six in work, and the firm had written guaranteeing to maintain and renew all the fittings.

His Honour said if it was an alteration of the specification as a matter of business, they should have called the attention of the Committee to the matter. There was no question of fraud at all; it was merely a small matter, and there was nothing in it at all. Mr. Galloway would be excused from further attendance.

Judge Parry, in closing the inquiry, said he ought to say he was satisfied that Messrs. Wheatcroft and Hunt had made their statements in the public interest, but it was also due to say in relation to Messrs. Lacey, Clirehugh & Sillar that there was nothing like fraud, ill-doing, undue influence, or anything like that made out against them. He was prepared to say the same with regard to Sir Richard Mottram, though he might have been indiscreet. He found also that with regard to ex-Councillor Howarth and the other persons concerned there was no evidence on which they could rightly be charged with fraud, ill-doing, cheating, or anything of the kind. He made the statement because he did not wish any stigma should rest on those concerned. As to minor questions, the Judge intimated he would report at length in due course. He mentioned that he excluded reference to Mr. Turner, because it might be necessary to go further into the dismissal question in case it should be advised.

Brighton.—A L.G.B. inquiry was held on 5th inst. into the application of the T.C. for sanction to borrow the sum of £5,500 for purposes of supplying electrical energy.

CORRESPONDENCE.

Re Mishap at Leeds.

Permit me to correct a statement made in your "Traction Notes" last week, in which it is stated that the cause of the car leaving the track and colliding with the Castleton Railway Bridge was due to the inefficient working of the brakes.

This is incorrect, as both the hand and emergency brakes were found to be in perfect working order when the car was replaced on the metals.

The driver has admitted that he was solely responsible for the accident, and states that instead of driving he was reckoning up his time while descending the grade and did not realize the speed the car was travelling at until he was at the curve, with the result that the car left the metals. Had he applied the emergency brake the car would have stopped directly it had run on to the setts. From evidence to hand it does not seem that he applied either brake.

John Burbridge.

Leeds, *June 4th*, 1902.

New Cable Relay.

The statements made in your leaderette respecting a new relay, invented by Mr. Sullivan, are rather remarkable.

I should be glad if you would give your readers, if possible, some particulars as to the construction of this instrument, the conditions under which it was tried, the length, together with the copper resistance of the cable experimented upon, and, of all things, the speed attained.

A Relayer.

June 9th, 1902.

[We have as yet no particulars of the construction of Mr. Sullivan's experimental relay. Mr. Sullivan informs us that it was tried with Morse signals and a battery power restricted to 12 Leclanché cells. A speed of 20 to 25 words per minute was attained, the messages being recorded on a Morse inker. Slips which we have seen are clear and good. The experiments were made upon a laid cable, having a retardation equal to that of 1,000 nauts of a particular and distant cable, for use upon which this type of relay was, in the first instance, invented by Mr. Sullivan.—EDS. ELEC. REV.]

Scientific Cruelty.

Will you permit me to say in reference to your note to Mr. Bailey's letter that the cat in question is stated in your report to have been at one period of the experiment "sub-conscious," *i.e.*, partially conscious, and we learn that more ether was given.

Edward Berdoe.

London, *June 10th*, 1902.

I am glad to learn, from the footnote below my letter in your last issue, that the cat, the subject of the experiment against which I protested, was unconscious until death. I certainly read the account to mean that the animal was conscious during part of the time. You argue that, as human beings operated upon under anæsthetics do not suffer pain, neither do animals under those circumstances. But the cases are not parallel. Anæsthetics are administered to human subjects with the object of averting pain; with animals this is not so. The late Mr. Cox, M.R.C.V.S., who, being a veterinary surgeon, was better fitted than any vivisector or other scientist to judge of the effect of anæsthetics upon animals, said that to assert that animals under chloroform or ether were therefore anæsthetised for any length of time was to be "either frightfully mendacious or grossly ignorant." Mr. Sutcliffe Hurndall, M.R.C.V.S., in his recent Presidential Address, said: "Among the general public the majority are under the impression that these so-called physiological experiments are conducted under the influence of anæsthetics, and that the subjects are rendered insensible to pain; this, however, is *not the case*, and I am informed that a large proportion—considerably more than half—of the licenses dispense with anæsthetics entirely. . . . . It cannot be otherwise, as, in the majority of experiments, the object of the vivisector would be defeated were the subject insensible. . . . . The phenomena of pain are absolutely essential to any practical issue, and even though it were practicable to conduct experiments under the influence of anæsthetics, it must be borne in mind that, as many of these experiments require time running sometimes into weeks, and even months, the animal would be only saved the actual pain of the operation itself to awake from sleep and experience prolonged agony and torment."

You, Sir, advocate vivisection, claiming, as the result of the cruel practice, benefit to mankind. That is, surely, a strange argument in favour of what is cruel, and, therefore, distinctly wrong. The plea of expediency is never accepted by magistrates in condonation of cruelty to animals or of any other wrong doing. You are doubtless aware that the utility of vivisection has been, and is, hotly disputed and flatly denied by very many medical men, both past and present, stating, in the plainest language, that vivisection is useless, misleading, and *dangerous*; and we know that, in spite of all the "scientific research," and the holocausts of victims sacrificed to this debased form of so-called science, disease, far from diminishing, has enormously increased.

Results, useful or otherwise, should not, however, be considered. Vivisection—the torture of animals—is gross cruelty to defenceless creatures; it is therefore a great wrong—*a crime*. No excuse can possibly make wrong right; no arguments advanced in its favour can ever justify the *crime* of vivisection.

C. A. M. Bailey.

Guildford, *June 10th*, 1902.

I quite agree with Mr. Bailey in protesting against the awful suffering inflicted on animals in the name of science. I am afraid that the consoling statement you make that the animal operated upon never recovered consciousness, even if true in the particular case to which reference is made, is also far from true in many others. I have never heard of results obtained by vivisection that are at all commensurate with the torture inflicted. You speak of the practice as having resulted in "countless blessings to mankind," but perhaps you would enlighten me by being a little more definite. Will you be good enough to cite, say, half a dozen instances (I will not ask for a countless list), in which results, beneficial to humanity, have been obtained by this revolting form of experiment?

A. R. C. Sc.

[We do not propose to enter into controversy with our correspondents with a view to convincing them; this is not the place to engage in such a profitless task, and no good purpose would be served by prolonging a discussion which is totally unsuited to our pages. The article in question dealt with the effect of electric waves on the human brain, a subject which is of undoubted scientific interest; the morality of vivisection is a side-issue, with which we are not specially concerned. We have allowed Mr. Bailey to reply to our comment on his first letter, and the correspondence must now cease.—EDS. ELEC. REV.]

Electrically-driven Feed Pumps.

With reference to the recent correspondence in your columns *re* electrically-driven feed pumps, you were good enough to insert some figures with regard to the efficiency of the patent "Hatfield" pumps which we supplied to the Bristol Corporation. These pumps were of large capacity, being capable of delivering 100 gallons per minute. We have now obtained some independent figures with regard to quite a small pump of the same type, and as the efficiency of auxiliary plant is now being seriously considered, we think possibly the figures may interest your readers.

The pump in question is capable of delivering 3·42 gallons

per minute against a pressure of 135 lbs. per sq. in., and when doing this work, the motor driving this pump takes 5·5 amperes at 103 volts. The pump is belt driven, and assuming, therefore, the efficiency of the motor and belt to be 80 per cent., the efficiency of this small pump works out at nearly 60 per cent, and the efficiency of the whole plant close on 50 per cent.

We think that for such a small pump and motor this is an extremely good result, and speaks well for the economy of electrically-driven pumps when properly designed with a view to being driven from an electric motor.

Merryweather & Sons, Limited.

Water Softening.

Regarding the remarks upon water softening in your last issue, it is well for us always to bear in mind the fact that boilers and economisers are for steam raising purposes, and should not be used for chemical operations.

Means may be provided by some economiser makers for scraping the inside of the tubes, and so removing the scale, but why allow it to get there at all?

I am at one with Mr. Boby when he says that each case requires to be considered separately, and upon its own merits. This is a most important fact that is not appreciated as it ought to be.

While readily admitting that the hot process of water softening for boiler feed purposes, under certain circumstances, has advantages over the cold process, I cannot appreciate the application of the *hot process for softening cooling water*. Surely Mr. Boby would have done better to apply the cold process for the cooling water, and drawn the "make-up" from the soft cooling water, passing it along with the rest of the feed water through a suitable feed water heater.

William Paterson.

Glasgow.

Edison's Battery.

Referring to Mr. Hibbert's very able article on "Edison's Battery," there is one slight error which I should feel obliged if you will correct, namely, "The British Electromobile Company used one of the 'A B C' (Oppermann) batteries in one of their carriages." As this is likely to cause some confusion, I wish to point out that in all the long-distance runs which have been made with the "A B C" battery, only "Oppermann electric vehicles" have been used.

Per **C. Oppermann,**
C. A.

[Mr. Hibbert was not responsible for the passage to which Mr. Oppermann draws attention. That was interpolated by ourselves on the authority of numerous published statements which were appearing at the time.—EDS. ELEC. REV.]

NOTE.—Several letters have been received too late for insertion in this issue.

REVIEW.

The Electric Arc. By HERTHA AYRTON, Member of the Institution of Electrical Engineers. London: The *Electrician* Printing and Publishing Company.

Those who have followed the subject of the electric arc in the numerous papers of the last 20 years, will be glad that Mrs. Ayrton has now published an account of her own investigations in a complete form. The character of her observations, and the conclusions she drew from them, are well known from articles in the Press, and papers read before the Institution of Electrical Engineers, the British Association, and the Royal Society; and it is satisfactory to read in consecutive form the long argument of which one remembers many steps.

The subject of the book includes only the direct-current open arc. Some experiments on enclosed arcs, described in the 10th chapter, were tried only for the purpose of elucidating the cause of hissing in open arcs, and the alternating-current arc is not referred to at all. Within these limits, Mrs. Ayrton has done her work very completely, and the book must for the present be recognised as the principal authority on this part of the subject.

To many readers the most interesting part of the work will be the chapter, "A Short History of the Arc," which consists of notes of early observations of the phenomenon. Most of us know that the arc had been observed, and its name applied at the very beginning of the last century, but it is surprising to find that as early as 1821 it was recognised to consist in an atmosphere of sublimed carbon. This chapter concludes with a list of published papers on the subject from one by Sir Humphrey Davy in 1801, to those of Blondel and Fleming in 1897—8.

The most completely satisfactory part of the book is the account of the investigations which led to the formulation of the law for normal arcs, $v = (a + b\,l) + (c + d\,l)\,A^{-1}$, where v, A are the potential difference between, and the current along, the carbons, a, b, c, d, depend upon the quality and size of the carbons, and l is the perpendicular distance between the cone and the plane of the crater's mouth. The establishment of this formula by a long series of concordant observations was evidently a most important step, and cleared the ground for further investigation. What are the physical significations of a, b, c, d? and how is the somewhat arbitrary definition of l to be improved? Might not the formula be elucidated by using the mean distance between the cone and crater surfaces, as the linear measure of the arc? The well-known diagram illustrating the action of the regulating resistances in determining the stability of arcs of different lengths, is a striking example of the use of plotted observations. No other equally striking occurs to us, and we should be glad to see Mrs. Ayrton's name permanently connected with her diagram as that of the late Prof. Tait with the thermo-electric diagram.

The chapters on the power and light efficiencies of the arc are very valuable, and may prove suggestive to manufacturers of arc lamps and carbons. The problems are formally solved, but full solutions depend upon the qualities of particular carbons; and new kinds of cores or additions of metallic salts may affect the results in unforeseen ways. The recent introduction of flaming carbons, in the arc of which the gaseous envelope is itself luminous, so that the crater is not the only source of light, may change the practical problem of arc lighting in several directions. It appears at first sight that with flaming carbons Mrs. Ayrton's main conclusion, that of her paper at the Paris Conference of 1900, would not hold. She here showed clearly that for efficiency ordinary open arcs should be burnt as short as possible, and with the largest currents that would not hiss.

The matter of the chapter on the circumstances and cause of hissing arcs is due entirely, we believe, to Mrs. Ayrton's own work, and it is not often that an experimenter can claim the credit of so complete an investigation.

The final chapter on the mechanism of the arc, to which the reader will naturally turn with great interest, is in some ways the least satisfactory. The view is now generally accepted that the space between the ends of the carbons is occupied by carbon mist surrounded by a sheath of burning carbon gases, and that over the surface of the crater carbon is passing from the solid into the gaseous state. The grounds for this view are stated clearly and cogently, but the argument of much of the chapter is not so lucid. Messrs. Frith and Rodgers some years ago described experiments to the Physical Society showing that an increase of current in the arc might be accompanied by a momentary diminution in the difference of potential between the carbons. This was interesting, but not astonishing. If water flows through a pipe ending in a freely perforated elastic diaphragm, a small impulsive pressure at the inflow may for an instant open the holes in the diaphragm sufficiently to allow a larger current of water to pass with a smaller loss of pressure than before at the diaphragm itself. Mrs. Ayrton explains Messrs. Frith and Rodgers' result by supposing that a small impulsive rush of current through the arc may momentarily expand the film of carbon vapour over the surface of the crater, at which point the main fall of potential occurs. This explanation seems quite satisfactory, and is corroborated by an observation by Mr. Duddell of a small interval of time between the increase of current and the fall in the potential difference. The joint paper attracted attention at the

time through the startling way in which the authors stated their conclusions, and drew from Prof. S. P. Thompson a sensible paper on the use of the words "resistance" and "electromotive force," which had been loosely applied by them.

The greater part of the present chapter deals with two questions. What are the resistance and back E.M.F. of the arc? What is the bearing on the subject of the results of Frith and Rodgers, Ray and Watlington, and Duddell, who have all experimented with small alternating currents imposed on the direct current arc? We take Mrs. Ayrton's answer to the second question to be that the arc is extraordinarily mobile and responds so quickly to changes in current that we cannot treat the body of conducting vapour and gas as being identical when the current is and is not pulsating, at least for the frequencies hitherto employed; and that the results of experiments in the latter case cannot be used to determine the resistance in the former. The first question, viz., of the resistance and back E.M.F. of the arc is confused by the mode of statement, as there is no clear explanation of the distinction between the two modes of the conversion of energy, and the argument on page 399 seems to be pure assumption. The considerable fall of potential near the surface of the crater has been usually called a back E.M.F. Mrs. Ayrton believes it to be due to the passage of the current through a film of carbon vapour, whose area expands or contracts so as always to be proportional to the current, and that the conversion of energy and corresponding fall of potential takes place in the body of the film, and not at the surface of the crater where the sublimation of carbon occurs. She considers the mode in which energy is converted to be analogous to that by resistance in the body of an electrolyte, not to that by electrolysis, at the surface of the electrodes. The view seems probable and reasonable enough, in spite of the absence of any direct evidence either way; but we think it would be more easily grasped if it were not stated in terms of a word "resistance," whose meaning in this connection is ill defined.

We can heartily recommend Mrs. Ayrton's book as a record of conscientious and painstaking, and occasionally brilliant, work.

BUSINESS NOTES.

Armorduct.—Mr. Fred. Bathurst, of the Armorduct Improved Electric Conduit Co., of 3, Oxford Court, E.C., reports encouraging progress in respect to the development of this improved electric conduit. In order to better cater for country customers, the company is arranging local agents and stock depôts in the larger towns and electrical districts. Messrs. J. and A. Anderson, of 62, Robertson Street, Glasgow, have been appointed agents for Glasgow and district, and Messrs. Atkinson, Schmahl & Co., of 5, St. Nicholas Buildings, Newcastle-on-Tyne, will take care of this other important northern district, and they already have a comprehensive stock on hand. The A.I.E.C. Co. invite inquiries from electrical firms not actually contractors as to agency in other districts.

Books Received.—"Transactions of the North-East Coast Institution of Engineers and Shipbuilders"; session 1901—2. Vol. xviii., part 4. London and Newcastle: Andrew Reid & Co., 1902.

"L'Electricité déduite de l'Expérience et ramenée au principe destraraux virtuels," by M. E. Carvallo. Paris: C. Naud.

"Report of the Royal Commission Appointed to Inquire and Report on the Working of the Coal Mines of New Zealand, 1901."

Coronation Illuminations.—A simple modification of an ordinary incandescent lamp has been devised by Mr. W. Barker, of 1, Derby Street, Preston, by means of which it can be adapted for stringing on wires for illuminations at a trifling expense, without requiring any holder, and can afterwards be restored to its previous condition. There seems to be no limit to the stock of ingenuity available in this class of work.

Electric Fans.—Messrs. Johnson & Phillips are circulating particulars of electric desk fans, this being a new branch of manufacture with the firm. Prices and details of 12 in. desk fans are given. The chief points kept in view in the design and construction of these fans have been efficiency, durability and artistic appearance.

Switzerland.—According to a report from Munich, the Aluminium Industrie Gesellschaft, of Neuhausen, Switzerland, has secured an option of a new process for the electrolytical production of steel direct from iron ore.

Electrical Wares Exported.

WEEK ENDING JUNE 11TH, 1901.		WEEK ENDING JUNE 10TH, 1902.	
Adelaide	Value £71	Amsterdam	Value £175
,, Teleg. wire	2,200	Auckland	631
Alexandria	48	Bangkok	131
,, Teleg. wire ..	42	Barcelona	91
Amsterdam	80	Boca. Teleg. poles	84
Archangel	229	Bombay	237
Bombay	315	Brisbane	53
,, Teleg. cable	82	Buenos Ayres. Teleg. mat. ..	357
Bremen	20	Calcutta	616
Buenos Ayres. Teleg. apprts. ..	277	,, Teleg. cable ..	800
,, Teleg. wire ..	240	Cape Town	86
Calcutta	1,060	Channel Islands	150
,, Teleg. mat.	22	Coatzacoalcos	18
Callao. Teleg. wire	46	Colombo	119
Cape Town	1,650	Copenhagen. Teleg. wire ..	63
,, Teleg. mat. ..	1,307	Durban	931
Christiania. Teleg. wire ..	100	East London	441
Colombo	179	Fremantle	47
Copenhagen. Teleg. mat. ..	186	,, Teleg. mat.	148
Durban	946	Liban.	112
,, Teleg. cable	128	Melbourne	170
East London	73	,, Teleg. wire	1,345
,, Teleg. mat. ..	1,127	Perth	1,276
Fremantle	12	Port Elizabeth	402
Flushing	39	Rangoon. Teleg. cable	245
Gibraltar	15	Rotterdam	100
,, Elecl. instruments ..	700	St. Petersburg	950
Hobart. Teleph. cable	730	,, Teleg. mat. ..	79
Hong Kong	12	Santa Cruz	41
,, Teleg. apparatus ..	23	Santos	42
Malta	132	,, Teleg. mat.	96
Mauritius	20	Shanghai	172
Melbourne	22	Sydney	395
,, Teleg. cable ..	1,308	Teneriffe	60
,, Telephones	47	Trieste	127
Montreal	100	Wellington	270
Nagasaki	40	Yokohama	27
Penang. Teleg. mat.	40	Zanzibar	24
Port Elizabeth. Teleg. mat. ..	247		
Rangoon	57		
Rosario. Teleg. mat.	320		
Rotterdam. Teleg. mat. ..	891		
St. Petersburg. Teleg. mat. ..	500		
Shanghai	180		
Singapore	42		
,, Teleg. apparatus ..	407		
,, Teleg. mat.	41		
Stockholm. Teleg. wire	715		
Sydney	1,519		
Wellington. Telephones ..	1,650		
Yokohama	511		
Yokosaka	2,578		
,, Teleg. cables ..	3,754		
Total ..	£26,640	Total ..	£11,062

Foreign Goods Transhipped.

Bombay.	Elec. fans	Value £143	Channel Islands.	Elec. cable	Value £105
			Sydney.	Elec. lamps	75
				Total	£180

Catalogues and Lists.—We have received from the Sandycroft Foundry Company, Limited, of Chester, a copy of their new and revised catalogue of dynamos, motors, &c. The works have been lately equipped with the most modern machinery and tools, placing the company in a favourable position for giving low quotations consistent with first-class workmanship and material. Their long and varied experience in the design and manufacture of mining plants, combined with the manufacture of electrical machinery under one roof, and in the same shop, should give opportunities of carrying out this class of work with economy and efficiency. A specification of protected and enclosed dynamos and motors, with some useful drawings and pictures, also details as to dimensions, are included. The company's machines are stated to be largely used in mines and collieries, and for this reason they have been designed on very liberal lines, both electrically and mechanically, and will give their specified outputs continuously with a low rise of temperature, and with the minimum of attention. They may be either shunt series, or compound-wound, to suit the work they are required to perform. Machines up to size 21 B are built to stock, and nearly completed. The protected and enclosed type machines are of a new design, which, while protecting the armatures and fields from mechanical damage, leave the commutators easily accessible. The casings of these machines are symmetrical, the same covers being used at commutator and pulley ends; this gives the machines an extremely neat and pleasing appearance. The same castings are used for both the protected and the enclosed machines, the enclosing being effected by means of covers completely closing the apertures in the end castings; they are then practically gas and water tight. Particular attention has been paid in the designs to making the commutation thoroughly satisfactory, with the result that the brushes can be fixed and the lead kept constant with varying loads.

From the B.T.H. Co., Limited, we have received a copy of pamphlet No. 125 describing and illustrating the GE 67 traction motor; also a printed index to pamphlets they have issued up to May 15th, 1902, and a new list of the B.T.H.-Edison incandescent lamp.

A list of reflectors, celluloid balls, luminous flowers, &c., has been sent to us by Mr. Henri Bean, of 226, Rue St. Denis, Paris. The designs are elaborate and striking.

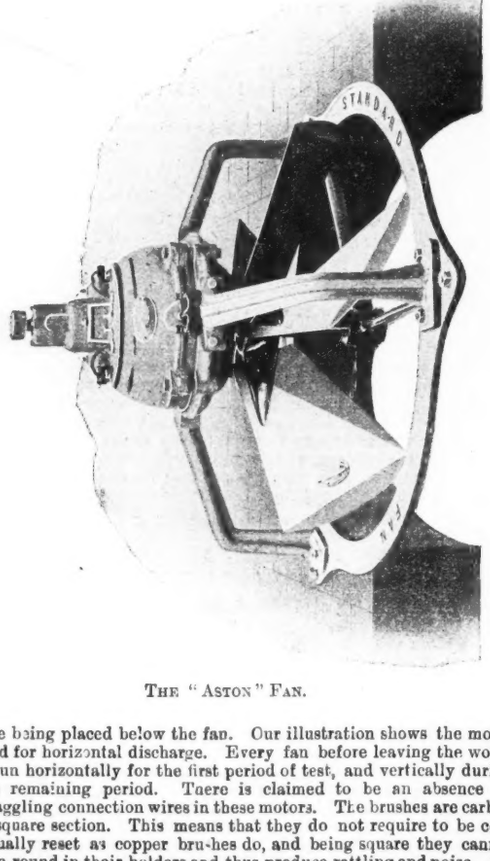
Messrs. Nalder Bros. & Thompson, Limited, of Queen Street, E.C., have sent us a copy of Sec. 1 of their new catalogue. It illustrates, prices, and gives other details respecting soft iron solenoid instruments, electrostatic voltmeters, accumulator cut-outs, &c. The company will shortly be bringing out three other sections, and these will deal (Sec. 2) with moving coil ammeters and voltmeters; (Sec. 3) recording instruments; and (Sec. 4) the firm's manufactures in automatic switches and circuit breakers.

Messrs. Rhodes & Webster, of the City Electrical Works, Sunbridge Road, Bradford, have sent us a descriptive bulletin No. 51, and price list of their R.E. type enclosed and semi-enclosed motors. We understand that these motors are the result of many years' experience of dynamo and motor design, and are up to date in every respect. The system of manufacture is thoroughly modern, and on the soundest principle; all parts are made separately to stock in quantities, and are, therefore, interchangeable. The firm's works are fully equipped with labour-saving tools, and the motors are entirely English made. The lists before us give full details, and a number of capital illustrations of the motors.

The third edition of their "S" list has been issued by Messrs. O. Berend & Co. It is a trade price list divided off into several sectional parts, in which many illustrations, much matter of a descriptive nature, and prices are given of switches, cut-outs, resistances, automatic cut-outs and regulators, switchboards, and all accessories for electric light and power installations. The offices, showrooms and warehouse are at Dunedin House, Basinghall Avenue, E.C.

Messrs. Field, Mallett & Co., Limited, of 38, Mincing Lane, E.C., have sent us several lists of their "Mallett" steam separator, and the Hyde duplex vertical boiler, made by Tinker, Shenton & Co., of Hyde. Messrs. Field, Mallett are sole agents for these boilers, and also for the following:—Shillingford Engineering Company, Limited, Cheltenham, "Trusty" oil and gas engines; Carbrook Steel Works, Limited, Sheffield, steel forgings and rolled steel shafting; Portland Bolt and Nut Company, Limited, Birmingham, bolts, nuts and rivets.

Aston Fans.—Messrs. Veritys, Limited, of Manchester, have issued a new circular (No. 43) in which their "Aston" electric fans are particularised. These are shown with prices for 15 in. to 60 in. diameter with open or box blades. They are of the propellor ventilating type, and silent running, selection of speed, efficiency, construction, invertibility, and the motor details are the six heads under which special features are claimed. It is claimed that a large volume of air is moved by the "Aston" fan for a small consumption of energy. The fans and frames are very substantially built. The "Aston"-Lundell is a most compact type of motor and most suitable for fan driving. Illustrations in the list show the motor separated from the fan, and also the component parts of which the motor is built up. The fan blades, except in the larger sizes, are of brass, polished and lacquered. The motors and frames are enamelled slate colour. Thrust discs are provided, and the lubricating arrangements are such that any fan can be used either for horizontal or vertical discharge, the motor in the latter



THE "ASTON" FAN.

case being placed below the fan. Our illustration shows the motor used for horizontal discharge. Every fan before leaving the works is run horizontally for the first period of test, and vertically during the remaining period. There is claimed to be an absence of straggling connection wires in these motors. The brushes are carbon of square section. This means that they do not require to be continually reset as copper brushes do, and being square they cannot turn round in their holders and thus produce rattling and noise. No brush rockers are used, but the holes through which pass the four bolts attaching the commutator bracket to the shell are slotted. This allows the commutator bracket, together with the brushes, to be turned round and set for sparkless running. Details of starters and speed regulators, output and input of fans, and useful tabulated shipping weights and sizes of fans are given in the list. Pressure blowers for forced draught as made for a number of British battleships are also shown.

Machine Tools.—We have received from the *Industrial Press* of New York a copy of Section A of the Mechanical Index, comprising machine tools, metal working machinery and accessories, machinists' small tools, &c. We understand that the complete index will be an encyclopædia and list of manufacturers in the United States of mechanical appliances and tools operated by steam, electricity, water, air, hand or foot power, carefully arranged under sub-headings for quick reference. The price of Section A is $1, and the date of issue May, 1902.

Italy.—A company has lately been formed in Milan, Italy, with a capital of £160,000, to establish large works for the manufacture of electrically-welded chains.

What the British Consuls Have to Say.—Vice-Consul E. H. Boxer (Bunder Abbas, Persia), in a recent report, states that the mercantile community of the port of Bunder Abbas consider that if the telegraph system of the Persian Gulf could be extended to that port, British trade would be greatly benefited thereby.

Electric light has been introduced into the town of Zante (Ionian Islands), the present Mayor—Mr. Macie—Consul Blakeney remarks, being a very energetic person.

Consul-General St. John, reporting on the trade of Peru for the year 1901, states that the town of Lima is now entirely lighted by electricity, and electric light is extensively used in private houses in Lima, being supplied by three companies. The town of Arequipa is also lighted to a considerable extent by electricity, and companies are being formed for lighting Callao, Trujillo, and Chiclayo by electricity. Electrical plant is said to be imported chiefly from the United States, but notwithstanding the initial advantages possessed by the United States in the matter of electrical plant, Mr. St. John thinks it is a branch of industry which fully deserves close attention on the part of British manufacturers, as the demand for electrical plant throughout South America, where there is so much water-power, must, he is of opinion, eventually become enormous. British machinery of that class, he states, is barely mentioned in Peru, while German dynamos and motors have been tried, but although well finished, they are looked upon as being too complicated. It is also highly probable, Mr. St. John believes, that a demand for power transmission lines for various purposes must arise sooner or later, as the natural configuration of the ground in Peru can be turned to account for the development of immense power, at comparatively little cost.

Telephonic networks, Mr. St. John states, exist in the departments of Lima, Piura, La Libertad, Arequipa and Ica. The total length of the wires is said to be probably over 3,000 miles. Moreover, a number of applications for further authorisations to put up new installations have been made lately. Most of the telephonic appliances are now imported from Sweden, only very small orders having been placed in the United Kingdom on the ground that the instruments and appliances made by British manufacturers are quite unsuitable for use in Peru. Inasmuch as the demand for telephonic apparatus must, in the near future, become very large in South America, Mr. St. John thinks this branch of industry may be deserving of more attention than it appears to receive at present in the United Kingdom.

Vice-Consul Reid reports that an electric light company has been formed for the purpose of lighting Trujillo (Peru). The company is said to have made the necessary contracts with the firm of Siemens & Halske, of Berlin, to supply and erect the machinery and lighting apparatus. The motive power is to be obtained from a waterfall on the River Moche, near the village of Poroto, about 21 miles from Trujillo. The waterfall, which is 180 ft., and acting on Pelton wheels connected directly with dynamos, is expected to generate an electric power of 200 KW., and this power is to be conveyed to Trujillo on the triphase system. The installation, Mr. Reid thinks, should be all complete by December this year, when, doubtless, there will be some demand for electric appliances. During 1901, he states, the Trujillo Telephone Company extended their connections to Ouizco, Huamachuco and Cajabamba, in all about 300 miles. Great difficulty is said to have been found at first on account of the electric storms which occasionally arise in those mountainous districts; now, however, the difficulties have been got over, and communication is said to be both safe and constant. What was at first regarded with terror, remarks Mr. Reid, is now in continual demand, and, besides the convenience, great advantages must accrue to business people from the use of this long-distance telephone.

Only electrical machinery and apparatus, remarks Consul-General Murray, in his report on the iron trade of Poland and Lithuania for the year 1901, will have for some time to be bought abroad. Steam engines, boilers, machinery, all iron necessary for building purposes, such as girders, &c., can be supplied by works in Russia, and it is, he thinks, certain that the import of iron will decrease continually. Referring to the public works of the Warsaw Consular district, Mr. Murray states that a concession for the electric lighting of the town was granted to Messrs. Schuckert & Co., of Nurnberg, who, however, have not yet started building the plant. Of certain improvements on the Government railway lines, which it was proposed to effect last year, only very few were carried out, as the Government did not assign the money for the purpose. The erection of electric plant on different stations, for example, was effected only in a few instances, and the construction of new lines was completely abandoned. The Czenstochowa-Herby line, which is to be worked with

electric traction, Mr. Murray reports, is nearing completion, so that traffic is likely to begin in the autumn of this year (1902).

Electric hoists are to be erected on a new deep water landing pier, which the Portuguese Government propose to construct at the port of Lourenço Marques. The pier as projected, Captain Fritz Crowe, R.N., his Majesty's Consul-General at Lourenço Marques, reports, will be situated between the small C.F.L.M. Railway pier and the Custom House, and merchandise will be discharged by the electric hoists direct from the vessels to the platforms of the large warehouses, which are to be provided with the necessary sliding doors to facilitate as much as possible the entrance and exit of goods.

The Telegraph system of Lourenço Marques, Captain Fritz Crowe states, remains much the same. The landline to Pretoria is in good working order, and the cable system of the Eastern Telegraph Company has throughout the year 1901 rendered excellent service. That, unfortunately, however, he states is not the case with the landline to Inhambane and Gazaland, which in the rainy season and at other times is constantly out of order. Reporting on the trade of Tete and district for the year 1901, Vice-Consul H. R. Wallis states that Tete is in direct communication with British Central Africa and Europe by means of the African Trans-Continental Company's telegraph line, and with the East Coast by means of another service over the Portuguese Government line; the latter, however, being carried on wooden poles and consequently subject to the ravages of insects, is only available at intervals for communication. An extension of this service, Mr. Wallis states, is being made to Zumbo, the most westerly town in Portuguese territory.

Sir W. F. Haynes Smith, in his report on the telegraphs in the Island of Cyprus for the year 1900—1901, states that the Eastern Telegraph Company, Limited, maintains a cable from Egypt to Cyprus, and landlines connecting the six principal towns of the island and the Troodos Government quarters. The Imperial Ottoman Telegraph Administration, he states, has also a cable to the coast of Asia Minor, but it has not been in working order for some time.

Reporting on the trade of the Consular district of Calais for the year 1901, Consul Payton remarks that on account of the glut of the fruit and vegetable traffic at Boulogne in previous years, it was decided in the spring of 1901 to divert the traffic to the Calais—Dover route so that advantage might be taken of, among other things, the greater facilities for loading by electric and hydraulic cranes. In connection with the passengers service, he was given to understand that electric cranes were to be completed early in the year, both at Dover and Calais, for direct transfer of luggage between train and boat, whereby it was estimated that 20 minutes would be saved on the journey between London and Paris. But, he remarks, the great desideratum is a system by which the whole truck-load can be bodily transferred from train to boat. Referring to the mail and passenger service between Calais and Dover, Consul Payton states that an instrument of the megaphone type, by a Belgium inventor, has recently been fitted up experimentally on two of the British mail boats for the more perfect recording of the distance and direction of sounds of fog-horn and other signals, while the French boats are provided with powerful electric projectors, sending forth a long and wide band of light in any desired direction, with a system of luminous signals for optic telegraphy. The production of submarine cables in the Calais Consular district, Mr. Payton reports, received a check last year owing to a fire at the Calais works, but notwithstanding that, 1,000 nautical miles of cable were manufactured in three months for the French Government.

Dissolutions and Liquidations.—A meeting of the Electrical Transmission Company, Limited, will be held at 7, East India Avenue, E.C., on July 15th to hear an account of the winding-up from the liquidator, Mr. A. R. Clarke.

Messrs. C. J. Cooper, S. W. Cooper, and J. E. Wilkins (Cecil Cooper & Co., electrical engineers, 14, Gloucester Road, South Kensington), have dissolved partnership. Debts, &c., will be attended to by the Messrs. Cooper, who will continue the business under the old style.

Trolley Standards and Heads.—Messrs. Brecknell, Munro & Rogers, electrical and mechanical engineers and founders, of Thrissell Street, Bristol, are manufacturing trolley standards such as are now being used on electric cars in London, Devonport, Sunderland, Yarmouth, Southend, Poole and Bristol, and a number of other places. Those used at Devonport, Yarmouth and Southend were supplied in connection with the Brush Electrical Engineering Company's equipment. They are also supplying a very light weight trolley head, in which both the wheel pin and swivelling bearing are automatically lubricated from a reservoir formed in the wheel.

ELECTRIC LIGHT AND POWER NOTES.

Aston.—A L.G.B. inquiry was held last week *re* the Council's proposed loan of £52,436 for electric lighting. The Council has had numerous applications from manufacturers asking when they would be able to be supplied with electrical energy, and all pressing on the Council the necessity for making such a provision.

Blackburn.—The report of the seventh year's working of the electricity undertaking shows total receipts for the year £20,738, expenditure £13,808, interest and sinking fund charges £8,244; loss for the year, £1,052 13s. 11d. The generating costs have been reduced from 1·32d. per unit last year to 1·01d., and the total costs, including management and distribution to the consumers, have been reduced from 1·78d. per unit to 1·48d. The electrical engineer, Mr. A. S. Giles, states in the report that, with the one exception of coal, all items in the costs compare favourably with other electricity works. The reason why the coal bill (£5,970) is so high is, that only part of the steam plant is worked condensing, and what vacuum is obtained on a portion of the plant cannot be maintained for many hours on account of the cooling water rising to such a high temperature. Mr. Giles estimates that if condensing on all the plant had been possible, the saving in the coal bill would have been over £2,000. In this connection the engineer reiterates the urgent need for additional cooling towers. The deficiency on the works up to date is £2,492 4s. 6d.

Blaenau Festiniog.—The district of Blaenau Festiniog has a large amount of water power running waste, and this in the midst of the large quarries giving work to and supporting over 23,000 inhabitants of the town and surrounding villages. Close on three years ago, the "Yale Electric Power Company" was formed for the purpose of utilising and developing this water power, and thereby cheapening the production of slates by supplying the quarries with power for pumping, driving the slate mills, hauling and like purposes, as well as for lighting; and the energy was further intended for lighting the public streets and offices, and for private consumers. Electric power is supplied at about 1d. per unit. The Folty and Bowydd quarry, and the Llechwadd quarry, have already taken a supply, and the public and private lighting is supplied under an agreement with the Urban Council at 4d. per unit for 15 years. The waterworks and massive masonry dam and the main supply station are situated at Dolwen, on the River Barlwyd, which runs from the surrounding mountains Moelwy and Foel Farlwyd. There is also a sub-station at Diphwys, Blaenau, where the pressure is reduced from 550 volts down to 230 volts for the purpose of public lighting. The plant at Folty and Bowydd quarry, comprises several winding engines of from 8 to 150 H.P. each, electrically-driven pumps, &c. At Llechwadd quarry there is also a plant which includes a mill. The dynamos and motors supply energy at 550 volts for power purposes, and at 230 volts for lighting. The dynamos have been running for the last two years with great satisfaction, and were supplied by the Sandycroft Foundry Company, Limited. There are now motors to the extent of 400 H.P. actually connected with the mines, and a very large number of glow lamps, besides the 11 arc lamps for lighting the street, and two railway stations. The batteries which are used during light-load times were supplied by the Tudor Accumulator Company. At the opening ceremony Lord Newborough was accompanied by a distinguished party, including Hon. C. H. Wynn, Rug Corwen; Sir Henry B. Robertson, Pale; Mr. Thomas Jones, M.I.C.E., London, Lord Newborough's agent and engineer to the Oakeley quarries, Festiniog; Messrs. Sydney and Frank Taylor, of the Sandycroft Foundry Company; Mr. T. P. Osborne Yale, managing director of the Yale Electric Power Company, and others. The party inspected the plant at the two quarries, and thence proceeded down the valley about two miles to the waterworks and generating station, where his Lordship performed the ceremony of switching on the electric supply to the Diphwys sub-station. On reaching Diphwys his Lordship went through the ceremony of starting the lighting machinery, to which he had already switched on the supply at Dolwen.

In the evening an banquet was held at the Queen's Hotel under the presidency of Lord Newborough, when there were over a hundred guests, being managers of the quarries in the district, and public officials. During the banquet Lord Newborough switched on the public arc lamps, and declared the supply to the public open.

Blaydon.—At a meeting of the D.C. on 5th inst., a letter was received from the owners of the Priestman Collieries offering to supply the Council with electricity for 15 lamps at Rowlands Gill, and nine lamps at Barlow, the Council to pay the firm £90 for Rowlands Gill and £60 for Farlow, and in the event of the firm being stopped during the next five years from making such distribution, the Council would be required to idemnify the firm to the extent of further £90 and £60 respectively. The offer was accepted.

Bloemfontein.—When the last mail to hand left, excavations were being carried on adjoining the electric light generating station, to prepare for the additional plant, which was expected daily.

Bristol.—It has been decided to extend the water-softening plant and to carry out other improvements at Temple Back, at an estimated cost of £2,915.

The City Council on Tuesday discussed a report from the Sanitary Committee recommending an important extension of street lighting by arc lamps. The Council had already agreed to the extension as a matter of principle, and now discussed the details of the scheme. The extra lamps proposed number 365, and the additional cost over the present gas lighting will amount to £2,783 per annum. The lighting will be, of course, a great improvement on the present gas lamps. The discussion chiefly arose on the claims put forward by districts not on the list that they might be included, but the chairman of the Committee explained that the present scheme was the result of a conference with the Electrical Committee, and further extensions must be left for the future. The report was adopted.

The Electrical Committee have put up in College Green and Park Street for experimental purposes a number of Bremer lamps in place of the older pattern. Their warm yellow glow has been favourably commented upon, and it is thought that the Bremer

pattern may have a considerable chance of adoption in the extended scheme of street lighting. The consumption of electricity is said to be about half that of the older type of lamps, and the yellow light is rather the better of the two.

Bridgend.—The South Wales Electric Light and Power Company on Tuesday commenced erecting a generating station at Bridgend.

Cardiff.—The borough electrical engineer has reported to the E.L. Committee that for the year ended March 31st last the revenue has gone up from £11,153 to £15,515, an increase of over £4,400. The payments have included £8,255 works cost, £5,692 interest and repayments, and the surplus balance to the credit of the rates is figured at £1,106.

Colchester.—Colonel Smith, R.E., L.G.B. Inspector, held an inquiry at Colchester on the 5th inst. into the application of the Corporation for leave to borrow £8,500 for further electric light extensions.

Coventry.—Major C. E. Norton, R.E., conducted an L.G.B. inquiry at Coventry on 9th inst. regarding an application by the Corporation to borrow £20,485 for additional electric lighting plant, and £2,000 for the purchase of motors for letting out on hire. The scheme submitted was for replacing the single-phase plant with a two-phase plant, and to increase the standard of the generator from 400 KW. to 600 KW., to provide a duplicate and accessories necessitated by the re-arrangement of feed pipes, filters, and so forth. In reply to the inspector, the town clerk said the outstanding debt on the old plant was £1,015, whereupon the inspector gave instructions that that amount would have to be deducted from the present estimate. With regard to the loan for the purchase of motors, it was submitted that there was an increasing demand for electric motor power. There had been an unwillingness on the part of intending customers to purchase motors, and looking at the analogy of the gas undertaking, which hired out gas stoves for the purpose of increasing their custom, it was thought it would be a useful thing to hire out motors. Mr. J. H. Jeckell, Corporation electrical engineer, submitted a detailed statement of the proposed adoption of the two-phase system, and gave particulars as to the cost and advisability of the improvements.

Cromer.—The Council is to raise a £25,000 electric lighting loan.

Dartmouth.—The Electric Lighting Company has undertaken to supply electricity for public lighting by August 15th.

Dawlish.—Mr. J. A. Purvis, of Sidmouth, stated at a U.D.C. meeting that he would be glad to know if the Council would be prepared to consider an offer from him for the introduction of electric light in the town. His suggestion was that his friends, Messrs. Crompton & Co., Limited, should put up and work a complete electric light installation at their own cost and risk, giving to the Council, if desired, the option of purchasing the undertaking at stated periods. The letter was referred to the General Purposes Committee.

Dumfries.—At the monthly meeting of the T.C. on Thursday it was agreed by a majority of 16 to 6 to rescind the resolution adopted in September, 1900, when the Council resolved that they would themselves carry through the electric lighting installation and not lease the contract to any company. Judge Currie, who made this proposal, said he did so in order that the Council might now approach the matter with perfectly free hands. Prof. Capper's report on his visit to Dumfries for the purpose of advising as to an electric lighting installation generally has not yet been received.

Ealing.—The Corporation has decided to apply to the L.G.B. for sanction to borrow £7,881 for extending the feeder mains.

Epsom.—A L.G.B. inquiry was held on Tuesday last into the application of the U.D.C. to borrow the sum of £10,282 for electric lighting purposes.

Frome.—The Urban Council proposes to apply to the L.G.B. for sanction to borrow £16,400 for the purpose of installing electric light and power works.

Germany.—At the commencement of the present year the central electric lighting station at Strasburg, Alsace, was supplying current to an equivalent of 82,311 (60,186) 16-C.P. incandescent lamps, 1,208 (1,003) arc lamps, and 629 (493) electric motors. The figures in brackets represent the quantity being supplied at the beginning of the preceding year.

Glasgow.—The following is an approximate estimate of the work of the Corporation electricity department for the year ending June 1st, 1902. The figures are approximate only, but, compared with the previous year's deficit of £4,000 odd, they are encouraging. The total revenue to date for 1901—1902 is about £104,000, compared with £79,449 for the previous year. The total units sold are about 9¼ millions compared with 6¾ millions in the previous year. A great saving in coal has been effected, this year's expenses in this item being about £14,000 compared with £19,607 in last year's report. That this decrease is accounted for by cheaper coal is noted by the fact that the quantity of coal consumed remains about the same, viz., 33,500 tons, so that while an increase is indicated in energy sold, partly due to increased day load, the coal bill is actually less on account of economical working at the four generating stations at Port Dundas, St. Andrew's Cross, Kelvinside and Waterloo Street. It must, of course, be remembered that the late Exhibition of 1901 was a good customer during this period.

Halifax.—The Electricity Committee of the Hebden Bridge D.C. are taking steps to proceed at once to supply electricity to the district, and they have sounded the Halifax Corporation as to whether they can make any reduction in the charges agreed upon for the supply in bulk in October last. The Halifax T.C. on Wednesday last week declined "to vary the terms of supply." The fact is, says our correspondent, it is rather an inopportune time for the Hebden Bridge people to ask a favour of the Halifax municipality. Recent events have caused much irritation at Halifax on the subject of supplying electricity and tramway facilities to the Hebden Bridge district. They are being mulcted in an expenditure of some £2,000 in having to take up and re-lay the cable from the electricity sub-station at Hebden Bridge to the centre of the village because it was not laid in accordance with the regulations of the Local Government Board. At last week's Council meeting the work was ordered to be done, the minute to that effect being cryptically worded as follows:—"That the electrical engineer be instructed to carry out the works necessary to bring into immediate use the cable laid to Hebden Bridge."

A new apparatus to prevent run-backs is being tested on six of the electric tramcars at Halifax. If it answers satisfactorily, all the cars will be fitted with it.

The Corporation are experimenting with four "Flame" arc lamps at Wards End. It is stated that one of the reasons for the experiment is that the current has been changed from alternating to direct.

Hereford.—The Council last week adopted the report of the E.L. Committee, which reads as follows:—

1. Your Committee regret that the results for the last financial year are not so satisfactory as during the preceding 12 months. The profits made in the year ending March 25th, 1901, were not only sufficient to pay the interest on the capital, but to provide over £700 towards the repayment of capital, leaving only £85 to be borne by the rates. In the present year the surplus revenue, after providing for the interest on the debt, is only £407 10s. 6d., leaving £392 9s. 6d. to be provided out of the rates.

Your Committee told the Council 12 months ago that they could not anticipate to report as favourably in the immediate future as on that occasion, but they had hoped to have had to ask for a smaller sum than that mentioned above, but part of the amount is due to exceptional expenditure, part to the rebate made to customers under the resolution of the Committee adopted by the Council reducing the period of maximum demand from two hours to one, and partly to the greater economy of some of the consumers.

The quantity of current supplied up to the end of 1901 was in excess of that supplied in 1900 by nearly 30,000 units, but the consumption during the first quarter of this year shows a very slight increase over the consumption for the corresponding quarter of 1901. This is believed to have been caused principally by the remarkably fine bright weather in February.

The financial results of the undertaking for the year ended March 25th, 1902, are as follows:—

Total units sold, 95,892, as compared with 86,098 units sold in 1900—1.

Of these there were charged at

	Units.	£	s.	d.
6d. per unit	66,749	1,668	14	6
4d. per unit	20,022	333	14	0
3d. per unit	6,851	85	12	9
2d. per unit	2,270	18	18	4
	95,892	£2,106	19	7
Less rebates on correction of consumers' accounts		4	3	1
		£2,102	16	6
Meter rents		94	6	5
Sundry receipts and portion of premium of apprentice		56	1	0
		£2,253	3	11
Less discounts, being the reduction due to the alteration of the period of the maximum demand		129	9	4
		£2,123	14	7
The working expenses for the year, including wages, salaries, oil, stores, coal, repairs, taxes, &c., were		1,123	0	7
Interest		593	3	6
		£1,716	4	1
Leaving a profit towards repayment of the capital of		£407	10	6

Ilford.—The U.D.C. has resolved to borrow from the Prudential Assurance Company a further sum of £2,500 for the electric light undertaking.

Italy.—The Prefecture of the Province of Cosenza has awarded a concession for a catchment of water on the Cardone of 200 litres per second destined to drive an electro-hydraulic installation for the purpose of lighting the town of Cosenza.

Kimberley.—The Town Council recently received an intimation from De Beers to the effect that on the latter completing their central power station, they would be in a position to supply electric power to the Council at 5d. per unit, and to private customers at 6d. At the present time the Council are supplying the light themselves, and are just now considering a scheme for the extension of the work. The proposals were, however, referred to a committee.

Kroonstad.—The Municipality have been authorised to borrow £25,000, of which sum £10,000 is to be devoted to electric lighting.

Russia.—The municipal authorities of Astrakan have just invited tenders for the establishment of a central electric lighting station in the town. It is primarily to have a capacity of 150 arc and 6,000 incandescent lamps.

Leatherhead.—The U.D.C. has transferred its prov. order to the Leatherhead and District Electricity Supply Company.

Leigh.—The annual report of Mr. J. Foster, electrical engineer to the Corporation, states that the capital expended up to date is £17,373. No money has been spent during the year in regard to new extensions except an instalment of £1,000 on the cost of the new steam dynamo. The length of mains laid on March 1st last was 5 miles 1,625 yards, the number of services laid during the year being 49. There are now 128 consumers with 9,403 8-C.P. lamps and 52 motors, 150,610 units being sold, and 438 supplied free for a public clock. The maximum load was 140 KW. Mr. Foster continues: "In commenting upon the progress made during the year, I can only say that this is highly satisfactory, being 96 per cent. over the previous year. There is a net profit of £80 18s. 5d. on the year's working, as against a loss of £101 10s. 2d. in 1901 and a deficit of £586 0s. 8d. in 1900."

Maritzburg.—Tenders were lately invited for certain electrical machinery and fittings for the local public works department yard.

Monmouth.—The high tension cables have been renewed by Messrs. Siemens, and details have been arranged in connection with the new plant.

Motherwell.—The T.C. has decided, owing to the satisfactory result of the first year's working, to reduce the price per unit for illumination purposes from 5d. to 4d., and for power up to 500 units from 2½d. to 2d.; to consumers of over that amount the price will be reduced to 1½d. The total cost of the lighting scheme has been £35,156, and the income derived during the first year just ended has amounted to £3,036.

Redditch.—A deputation of ratepayers waited upon the Urban Council on June 3rd relative to the noise, vibration and smell at the electric light generating station. A petition signed by about 100 inhabitants of the district declared that the nuisance caused serious damage to property, and one owner threatened to apply for an injunction unless the nuisance was abated. The Council promised that the matter should receive prompt attention.

Rhyl.—The U.D.C. has passed a series of resolutions authorising the borrowing of £14,640 from the Prudential Assurance Company for electric lighting.

St. Helens.—At the monthly meeting of the T.C., Alderman Beecham, chairman of the Electric Supply and Tramways Committee, stated that the profit from the department last year was £260 net. The number of units sold by the company last year was 600,000, which gave a revenue of £6,094. The increase of current sold was 38 per cent., and the increase of receipts 5 per cent. The current supplied for lighting had risen from 211,000 units to 267,000, and the revenue had increased by 30 per cent. The increase of revenue from current supplied for motors had been 83 per cent. The cost of production had been further reduced, being 1·04d. per unit. The average price received was 2·12d. per unit. The street lighting had been much improved, and the B.O.T. had sanctioned the use of overhead wires to transmit power to works.

St. Petersburg.—The three electric light companies in the Russian capital have recently concluded an arrangement whereby all competition with regard to future clients will be obviated. Each company will retain its existing customers, but will not encroach on the others' districts. At the commencement of the present year, the station of the Société d'Eclairage Electrique de St. Petersburg was supplying current to an equivalent of 222,741 10-C.P. incandescent lamps as compared with 183,790 at the beginning of the preceding year.

Southampton.—The L.G.B. have forwarded their formal sanction to the borrowing of £32,500 in connection with the proposed new electricity station on the Western Shore.

Sunderland.—The Corporation has now been supplying electricity for seven years; it was subsidised out of the rates to the extent of £2,669 during the first three years, then the undertaking commenced to pay, and for the last four years the gross profit has been £4,015. Out of this sum there has been repaid to the rates all that had been taken from them, and there remains a surplus of £1,346 after seven years' working. This is considered to be very satisfactory for a municipal undertaking. The staple industries at Sunderland are shipbuilding, engineering, and dock work, and the utilisation of electricity, except for lighting purposes, is small. A large engineering firm there has, however, applied for electrical energy for driving various machines, but has offered a very low rate per unit, at which the committee is quite unable to supply it. The borough electrical engineer, Mr. J. F. C. Snell, and the chairman of the committee, Alderman Bruce, have been going into the question of how far the whole of the very extensive shipyards on the Wear could be supplied at a low cost, yet profitably. A scheme is being formulated for submission to the Committee to carry this into effect, which will include the construction of district stations and the utilisation, to some extent, of the three-phase system. The present output for all purposes is about 2¼ million units per annum, and under the proposed scheme it will be about 4½ million units. The scheme is based on the assumption that the current can be supplied for motor purposes much more cheaply than at present, and when the scheme is carried out to its full extent, it will bring about a general reduction of cost to all consumers alike.

Swindon.—The Guardians have decided to light their workhouse by electricity, and have engaged an electrical engineer, of Manchester, to carry out the work. His estimate for laying down plant is £1,897, the annual cost of maintenance being £230. This will effect a saving of about £100 a year, as compared with the cost of gas.

Tunbridge Wells.—The Lighting Committee recommended, and the T.C. has agreed, that application be made to the L.G.B. for sanction for an additional loan of £10,000 to be borrowed by the Council from time to time as required for electric lighting extensions. This is on account of the progress the undertaking is making.

Wakefield.—The electrical engineer has advised the Corporation to borrow £55,000 for extensions to the electricity works. The question has been referred to a sub-committee.

ELECTRIC TRACTION NOTES.

Barcelona.—At the recent meeting of the Barcelona Tramways Company, held in London, Mr. J. B. Concanon told the shareholders that during 1901 they carried 33,787,925 passengers, an increase of 5,827,000, or 21 per cent. over 1900, that increase being carried on an increased mileage of 4¾ per cent. Mr. Concanon said that there was no tramway in Europe with 11 miles of street that carried anything like the number of passengers per mile of street. The best indication of the company's progress was the receipts per mile, and these had increased from 7$\frac{9}{16}$d. to 7$\frac{3}{4}$d. For the first four months of 1902 the receipts per mile had risen from under 7d. for the corresponding period, to a shade over 8d. But with that enormous increase in passengers, the receipts had not grown in proportion, owing to the adoption of ½d. fares over some portions of the system, with the view of driving omnibus competition off one of the best lines. This they had succeeded in doing, but the average fare was probably lower than any in the United Kingdom, viz., only a shade over ¾d. per passenger. An extension to Bonanova, 1½ miles, has been carried out, and is paying very handsomely.

Batley.—A commencement has been made in connection with the Corporation's electric tramway scheme, which is being carried out with the object of connecting the outlying portions of the borough with the centre of the town. The length of the line will be about 5 miles, and for a considerable distance at Staincliffe the metals will be parallel with the B.E.T. Company's line from Dewsbury to Heckmondwike and Cleckheaton. There will be a single track practically the whole length of the route, but pass-byes will be provided at convenient points. At present steam cars run between Dewsbury and Gomersal, passing through Batley and Birstall. This system is to be electrically equipped, and connected at Batley with the Corporation's scheme, and at Dewsbury with the Traction Company's lines. Satisfactory progress is being made with the latter company's undertaking in the Dewsbury and Ravensthorpe districts, and the laying of cables and erection of standards will be commenced at an early date. An agreement has been come to between the Dewsbury Corporation and the Traction Company for the supply of energy for Dewsbury, Ravensthorpe and Thornhill, and it is now reported that terms have been practically arranged between the company and the Batley Corporation with respect to the supply of energy and running powers over each other's lines.

Bilston, Willenhall, &c.—The British Electric Traction Company are now making considerable progress with the construction of the electric tramway in these districts. The line from Bilston to the boundary of the Urban Council's districts has been laid and electrically equipped; whilst the line from Willenhall to the boundary of that Council's district has also been laid, but the poles and electrical equipment have yet to be put up. Nothing has been done up to the present in order to connect these two populous districts with Wolverhampton, though negotiations between the company and the Corporation are in progress with the object of restoring communication. It is hoped that in a few weeks' time the trams will be running on these lines as well as on that between Bilston and the Fighting Cocks on to Sedgley and Dudley.

Clydebank.—An arrangement has been come to between the Corporation of Glasgow and the burgh of Clydebank, whereby the former agrees to work the Clydebank Tramways Order for a period of 42 years. The cost of the provisional order is given as about £1,000. The cars are to be running in about three months' time.

Doncaster.—On Monday last week the Mayor opened the first section of the municipal electric tramways. The section runs from Station Road to Balby and Hexthorpe, and other lines will be to the Race Course, Bentley, Wheatley, and Hyde Park. The plans and estimates for the construction of the various lines, car sheds, &c., have been prepared by Mr. W. H. R. Crabtree, the borough surveyor, under whose supervision the whole of this portion of the work has been carried out. The original estimates for the electrical equipment were prepared by Mr. J. N. Shoolbred, as consulting engineer. The specifications for the electrical equipment were prepared by Mr. C. A. L. Prusmann, the then electrical engineer, but now of Swansea. Since he left Mr. Wm. Wyld has had sole charge of the work. The Corporation has let nearly every branch of the work by contract, but carried out the excavation, concreting and laying of

the track by their own workmen, and these have been under the supervision of Mr. Tench. The rails are of steel in 60 ft. lengths, 4 ft. 8½ in. gauge, 94 lbs. per yd., centre grooved with diagonal ends, coupled at rail ends by fishplates and sole plates, and held in position to cross ties, and holding down plates and bolts, bedded in the concrete at 6 ft. invervals. The Grey Friars car shed, built by Messrs. H. Arnold & Son, of Doncaster, is 800 ft. long, and will accommodate 20 cars, but only 15 will be required in the early stages. The cars and trucks were supplied from Preston by Messrs. Dick, Kerr & Co. The estimated cost of the undertaking is £77,500, but the actual cost up to date is, of course, considerably less than this. The section opened on Monday last week has been inspected and passed by Major Druitt, of the Board of Trade.

At the opening proceedings, Councillor Smith, chairman of the Tramways Committee, presented a key to the Mayor, and said they had met to open the first two routes of their light railway system. After referring to the scheme in some detail, he said that all the contractors had given the Committee general satisfaction. He would also like to say how indebted they felt to their officials for the cheerful spirit that had characterised them through all their work—their town clerk, Mr. Crabtree, and Mr. Wyld, electrical engineer, who had had the responsibility of carrying out the electrical equipment.

The Mayor, in declaring the sheds and the tramways open, said he hoped the tramways would be a paying concern.

On the proposition of Alderman J. F. Clark, seconded by Councillor Manwaring, the Mayor was thanked for his services.

Councillor Dowson presented a miniature controller to Councillor Smith, the chairman of the Tramways Committee, and spoke very highly of his services during the progress of the work. Mrs. Beaton, representing Messrs. Dick, Kerr & Co., presented a silver-mounted controller to the Mayoress and Mrs. Smith, and the former (Mrs. Windle) controlled the first car. The three cars, containing the members of the Corporation and the invited guests, made a very successful run over the prescribed route. The cars were decorated with the national colours in honour of the peace declaration.

Later, the Mayor entertained a large company to luncheon at the Mansion House, and a short toast list was submitted. During the afternoon and evening the tramways were open to the public and 10,553 persons paid for travelling over the two routes. The speed allowed by the Board of Trade is from 6 to 10 miles an hour, and the cars are being run from 5.30 in the morning until 11 o'clock at night.

Glasgow.—Although the annual report for the year ending May 31st, 1902, is not yet issued, the following figures may be taken as pretty accurate, says our correspondent, as they have been obtained from an authoritative source:—

Total	1900—1901.	1901—1902.
Receipts	£484,872	£612,794
Passengers	132,600,000	163,600,000
Miles of track (double) open at end of financial year	49½	52½
Number of cars	380	480

The car-miles run for week ending June 7th, 1902, amounted to 248,760, compared with 212,768 for the same period in the preceding year. The first week's returns of year 1902—3 show an increase of £584 compared with the same week in 1901—2, in spite of the fact that since June 1st, 1902, it is possible to travel five ½d. stages, as compared with four, for 1d.

Consequent upon the appointment of Mr. Hamilton to the managership of Leeds tramways, Mr. Dalrymple, accountant to the department, is promoted to the new post of deputy manager, and receives an increase in his salary from £450 to £550; Mr. L. McKinnon, formerly of purchasing staff, is to be traffic superintendent, with a salary of £350; Mr. D. T. Liddell to be outside traffic superintendent, with a salary of £300; Mr. W. Clark, the engineer, receives an increase from £550 to £600, while Mr. Michael B. Field, the chief electrical engineer to the department, is raised from £450 to £500.

An arrangement has been come to between the Clydebank authorities whereby Glasgow obtains the lease of the tramways in that burgh. The County Council has approved of the Corporation running the cars along the roads under their jurisdiction between Glasgow and Kirkintilloch. The Scotstown extension has now been open for a week.

Hornsey.—The Middlesex C.C. have given the D.C. formal notice of intention to proceed with the construction of the light railway along Archway Road and Great North Road after two months from June 26th.

Leigh.—At the last meeting of the Tramways and Electricity Committee of the T.C. the Tramways Sub-Committee reported that at the request of the South Lancashire Tramways Company they had had an interview with the directors with respect to the construction by the company of further tramways within the borough, and that the company had undertaken to submit their proposals in writing. The borough surveyor presented a report on the advantages of a double-track system of tramways, together with a statement showing how the financial relations between the Corporation and the County Council in respect of main and secondary roads would be affected by the adoption of (*a*) a single-track system; and (*b*) a double-track system. Consideration of the report and statement was deferred. A Sub-Committee reported that they had ascertained from a number of consulting engineers the terms upon which they would undertake to advise the Council in connection with the construction of tramways within the borough and the obtaining of the necessary statutory powers therefor. They were empowered to appoint a consulting engineer for the purposes named.

Light Railway Progress.—Sir Francis Hopwood's report on the proceedings of the Light Railway Commissioners up to the end of last year shows a steady extension of transportation facilities under the 1896 Act. During 1901 Mr. Gerald Balfour's department confirmed 49 orders and rejected three, whilst 15 were passed on to the present year. To December 31st the total number of applications to the Commissioners, including amendings, was 379, of which the Board of Trade confirmed 143. All the applications did not, of course, go up for confirmation, as Lord Jersey and his colleagues rejected 81, and 51 were withdrawn by the promoters. The original schemes covered 3,600 miles, and involved about £27,360,000, but those finally submitted to Mr. Gerald Balfour represented only 1,340 miles, and not quite £8,880,800. The monetary assistance granted under the statute during the past year included £55,850 in free gifts, and £28,000 on loan at 3 or 3½ per cent. or without interest, but those sums embody readjustments of money previously voted.—*Financial Times.*

Liverpool.—The construction of the short length of electric tramway track which is to form the connecting link between the Liverpool electric tramways system and the line of the Lancashire Light Railways, at Knotty Ash, is now being vigorously proceeded with. The length of route track to be constructed is about a mile and one-third. The intention is to have the length completed by Coronation Day. The work is accordingly being carried on night and day under the direction of Mr. Brodie, Liverpool city engineer. The point at which the new line will join the Prescot line at Knotty Ash is slightly over 4½ miles from the Liverpool Town Hall.

London.—The L.C.C. Embankment Tramway proposal, to which we have referred several times lately, was last week before the House of Commons, and after some discussion the Bill was ordered for third reading. A motion was moved by Mr. Whitmore to insert a clause providing, "That it should not be lawful for the Council to construct any tramway southward of the southern boundary of the premises No. 6, in the precinct of the Savoy, upon the deposited plans," but the voting was only 106 in favour of this new clause, and 176 against.

Newcastle-on-Tyne.—At the meeting of the City Council on the 4th inst., the monthly report of the tramway traffic was submitted, and showed that the trams had carried 2,344,705 passengers; the receipts had been £10,527, or equal to 10·81d. per car mile. Mr. W. Cail, the chairman of the Tramways Committee, said that the passengers carried equalled 10½ times the population, and the average weekly receipts of £2,632 were £176 above the returns for the previous week on which he based his last statement to the Council.

Northampton.—The Tramways and Electric Light Committee has carefully considered the offer of the Northampton Electric Light Company to supply current for tramway purposes at 1½d. per unit. The Committee said it would be more advisable for the Corporation to erect a generating plant of their own.

Oldham.—The Tramways Committee have decided to give the Oldham, Bury and Rochdale Steam Tramways Company a week's notice to cease running in the borough. On termination of the lease, the Corporation allowed the company to run from the boundary at Royton to the centre of the town at a weekly rental, but now the surveyor is ready to go on with the work of conversion to the electrical system. This is the last section of the old tramways to be reconstructed. With the exception of one or two routes all the sections in the town have been completed, or the work is nearing completion.

St. Helens.—A long list of conditions on which goods traffic would be permitted on the tramway lines in St. Helens, which are the property of the Corporation and leased to the St. Helens Tramways Company, was drawn up at a meeting of the Electric Supply and Parliamentary Joint Committees last week. The list was adopted at the subsequent monthly meeting of the Council. The principal conditions are that as regards traffic originating or terminating in the borough of St. Helens the rates to be charged should not in any case exceed the lowest rates for the time being charged for the same class of goods on any part of the system of the South Lancashire Electric Traction and Power Company; that without the consent of the Corporation, the cars should not be heavier when fully loaded than 16 tons, or 3·2 tons on any one wheel. The minimum quantity entitling the company to electricity at 1d. per unit should be 1,000,000 units, the price being 1¼d. per unit until that quantity had been reached. The company are to reimburse the Corporation in respect of the cost of repairs, renewals, maintenance, &c., to the extent either of ¾d. per car-mile or ½d. for each unit used for goods traffic, in addition to the scale price fixed for current in the lease of 1898 as modified. There is to be no running of goods traffic on Sundays, and the company are to pay proportions of the gross rate per ton per mile charged in respect of the goods carried by the company or any other company, leaving working arrangements with them—during the first five years 2½ per cent., during the next five years 5 per cent., during the next five years 10 per cent., and during the remainder of the lease period 20 per cent.

(*Continued on page* 987.)

CARDIFF CORPORATION TRAMWAYS.

(*Continued from page* 946.)

The switchboard is of the standard Ferranti pattern, and consists of:—Ten feeder panels each of 600 amperes capacity, two return feeder panels each of 1,500 amperes capacity, one positive booster panel, one negative ditto, three panels for motor-generator and battery, one Board of Trade panel, four 300-kw. generator panels, two 900-kw. ditto, and four panels for controlling the supply of current for private and public lighting and power purposes, each of these panels having a capacity of 1,000 amperes.

On the front of the board there is a table standing out from the board 2 ft. 6 in., upon which the field regulating and motor starting switches are placed, the resistances being below the board. There are also four panels on the front of the table for controlling the works motor-generator, battery regulating cells, &c.

There are two independent sets of main bus bars for controlling the traction and lighting loads. Each of the bars has a section of 6 sq. in.

All the switches are designed for a current density of 60 amperes per sq. in. of contact area.

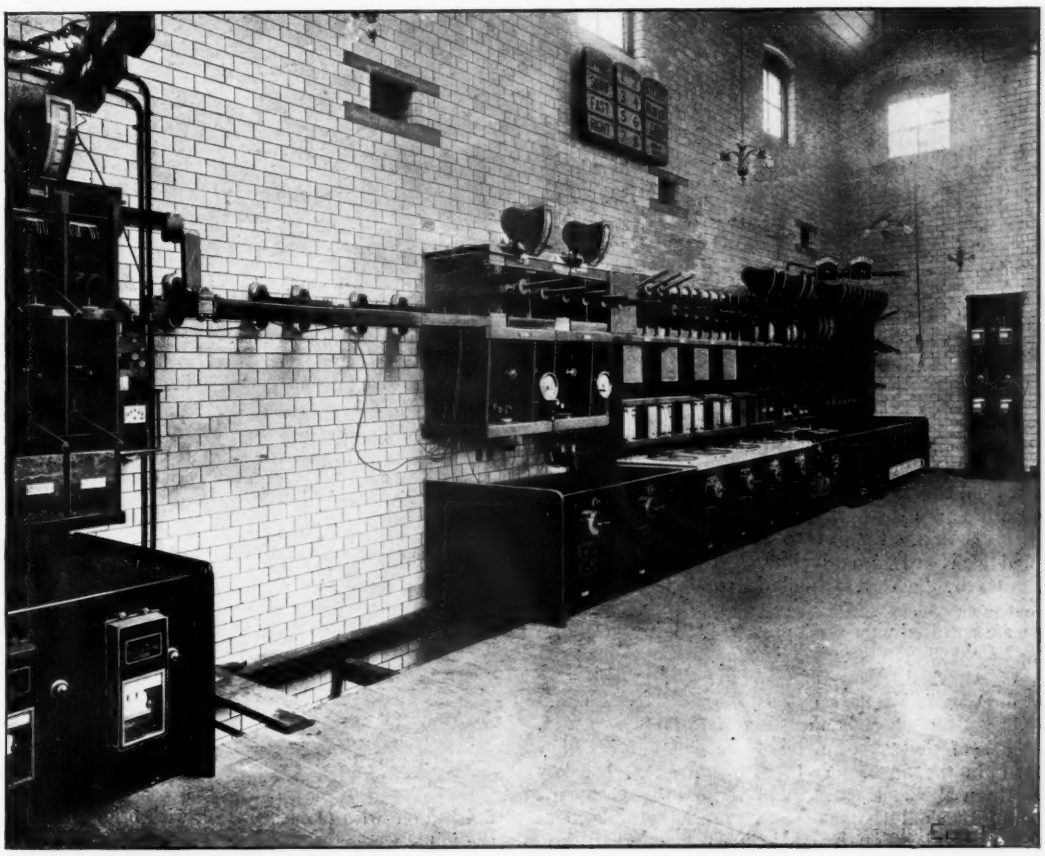
Each panel is fitted with an automatic circuit breaker of the Ferranti pattern, and the various instruments are of the edgewise pattern. The recording instruments were supplied by Messrs. Elliott Bros.; the watt-hour meters are of the Thomson type. There are three Weston illuminated-dial voltmeters at each end of the board for lighting and traction purposes.

There is an independent switchboard for controlling the works' lighting.

In the boiler house there are at present fixed four Lancashire boilers, 30 ft. × 8 ft., with provision for three more of similar size. These three boilers are at present being delivered. The boilers were supplied by Messrs. Musgrave and Sons, Limited, and are made for a daily working pressure of 150 lbs. per sq. in. Each boiler has two flues, with five cross tubes in each.

The boiler fittings were supplied by Messrs. Hopkinson, and are of their latest type.

At the rear end of each boiler there is a superheater of the Musgrave type, so arranged that it can easily be removed for inspection, the steam in the meantime going direct to the main steam range.



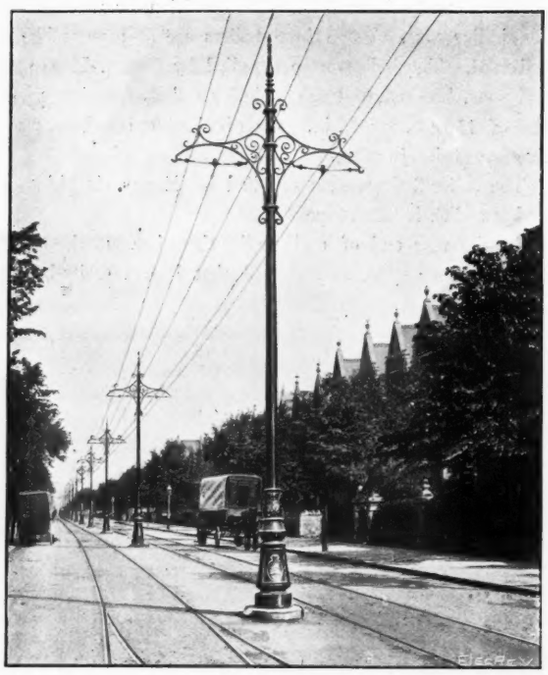
Ferranti Direct-Current Switchboard.

At one end of the boiler house there is a Green economiser consisting of 288 pipes, built into a bye-pass from the main flue. The scrapers are driven electrically.

The mechanical stokers, steel coal bunkers, ash conveyor, and elevator were supplied by Messrs. T. and T. Vicars. The stokers are of the coking type, and shoots are taken to each from the coal bunkers above. The ash conveyor is of the screw type, working in a trench in front of the boilers and independent of the blow-off trench. The elevator is fixed at one end of the boiler house. The general arrangement is such that a minimum amount of fuel handling is necessary.

The coal is brought direct from the colliery, and passes over the railway siding from the main line. It is weighed on a weighbridge at the entrance to the power station site,

and the trucks are delivered into the coal bunker building, where the coal is either put into the coal bunkers over the boilers or into the storage room below, which runs the full



CENTRE POLES IN CATHEDRAL ROAD.

length of the building, and is connected to the boiler house by sliding doors fixed opposite to each boiler. The fuel is only used from this store when hand firing is necessary.

The ashes are withdrawn from the fires, dropped through grids in the floor of the boiler house to the conveyor, and delivered into a hopper at one end, when they are taken up by the elevator and delivered either into railway trucks or carts.

There are two feed pumps at present fixed in the pump room, and a third one on order. The pumps were supplied by Messrs. G. & J. Weir, of Glasgow, and are of their vertical direct-acting type, each capable of delivering 6,000 gallons of water per hour at a pressure of 160 lbs. per sq. in.

The whole of the steam, exhaust, injection, and overflow pipes, and also the auxiliary and feed pipes, were supplied by the Sir Hiram Maxim Electrical and Engineering Company, Limited, of London, who have also on order the pipe extensions for the two large engines and three boilers. This firm also supplied the central gangway and switchboard gallery in the engine house.

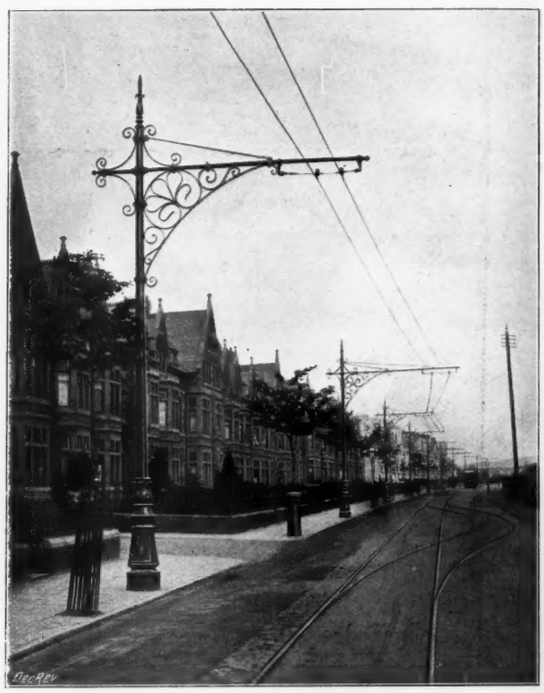
The steam pipes are made of best wrought-steel, and the other pipes of cast-iron. The main steam pipes in the boiler house are 18 in. and 14 in. in diameter, and are coupled to each boiler by means of a 7-in. branch, from which there is also a 7-in. bye-pass to the superheaters. The main pipes are coupled up to suitable water separators at each end of the boiler house. There is a large expansion bend in the centre of the range.

The main range in the engine room consists of two 14-in. pipes, supported by the central gangway. This range is coupled up through separators at either end to the boiler house range by 14-in. pipes. There are also expansion bends and separators in the centre of the engine house range. The steam branches to the engines are 6 in. in diameter.

The whole of the separators are drained through Geipel steam traps, delivering into a main drain pipe, which runs back to the cooling pond. The whole of the valves were supplied by Messrs. Hopkinson, of Huddersfield.

A duplicate system of 4-in. auxiliary steam pipes is provided for the pumps, with separators and drains.

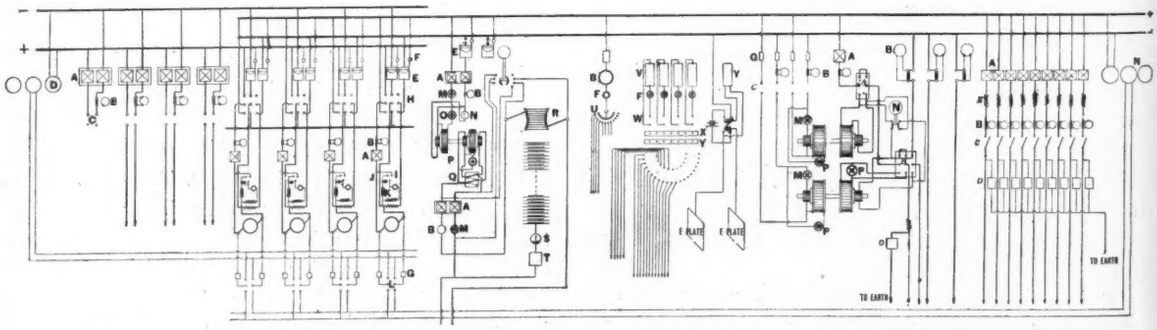
The whole of the steam pipes, as well as the engine cylinders, are covered with non-conducting cement, and



SIDE POLE CONSTRUCTION IN MINIAN ROAD.

finished off with planished steel, with bright steel bands at the joints.

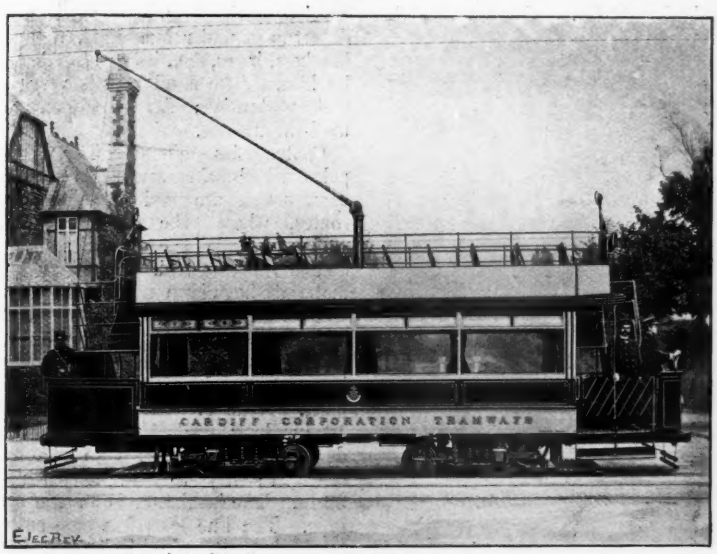
The cast-iron exhaust pipes are carried the full length of either side of the engine room, and are supported by means of brackets and hangers immediately below the crane gantry. The pipes at one end of the room are 12 in. in diameter, increasing to 22 in., with 12 in. branches to each engine; 18 in. branches are provided for the large engines on order.



A, Cir. bkrs.; B, Ammeter; C, D.P. sw.; D, I.D. voltmeter; E, w.-h. meter; F, sw.; G, Fuse; H, Throw-over sw.; I, Field switch; J, Lamp; K, Res.; L, V.m. sw.; M, Starting res.; N, Vmtr.; O, P, Reg. res.; Q, Ser. par. sw.; R, Battery sw.; S, Polarised ammeter; T, Auto. cut-out; U, 12-way sw.; V, Rec. v.m.; W, Plug cons.; X, Bus bars; Y, Rec. amtr.; Z, Two-way D.P. sw.; *A*, *B* Throw-over sws.; *C* S.P. sw.; *D* Lightning arrester; *E*, kicking coils.

MAIN SWITCHBOARD: DIAGRAM OF CONNECTIONS.

There is an automatic valve between the main exhaust and each engine.



Double-Deck Bogie Car.

The injection and overflow pipes are fixed below the engine room floor level and coupled up to the condensers. The injection pipes are 12 in. diameter and $\frac{1}{16}$ in. thick, with flanges $1\frac{1}{8}$ in. thick, and the overflow pipes are 20 in. in diameter, reduced to 18 in.

There is a duplicate system of feed-water pipes, of cast-iron, which deliver to the boilers either direct or through the economisers.

The blow-off pipes for the boilers are fixed in a trench in front of the boilers, and deliver into a tank at one end, from whence the water is pumped up into the brook, the boiler house being below water level.

A complete system of drain pipes from all parts of the station is provided to deliver the water into the cooling pond.

The engine room floor is chiefly constructed of cast-iron plates, which can by easily removed for getting at the pipes, &c., with mosaic work around each engine and at one end of the room.

At the front end of the buildings a large cooling pond is being constructed, the capacity being over one million gallons. The pond is being made by the Public Works Department of the Corporation under the directions of the borough engineer, who is carrying out the work in a very substantial manner. The whole construction is of concrete. The water from the condensers is delivered into a hot well at one side of the pond, and is led away by a trough with hurdles to the far side, to another well, from the bottom of which it is delivered into the pond through valves. The injection water is taken from a point where the water is coolest.

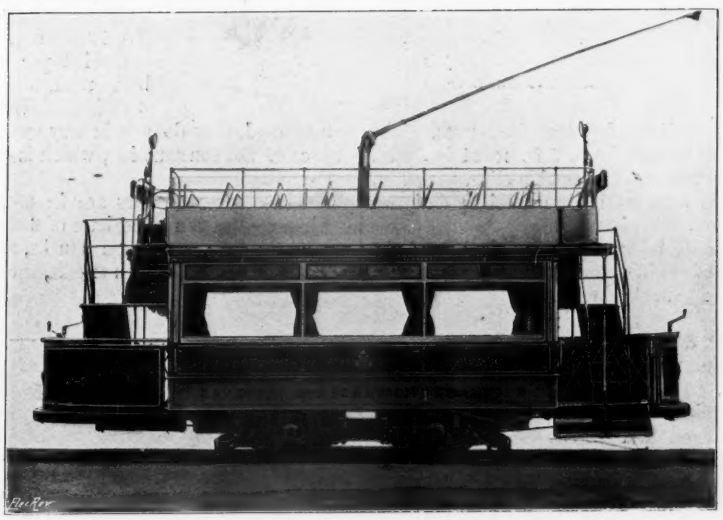
The pond is divided into two sections by means of a substantial wall, so that one-half at a time can be shut off for cleaning purposes. If, at some future date, cooling towers are found to be necessary, they can be built over the pond.

The lighting of the power station, which has been carried out on a large scale, was done by the staff of the electric lighting department, under Mr. Ellis.

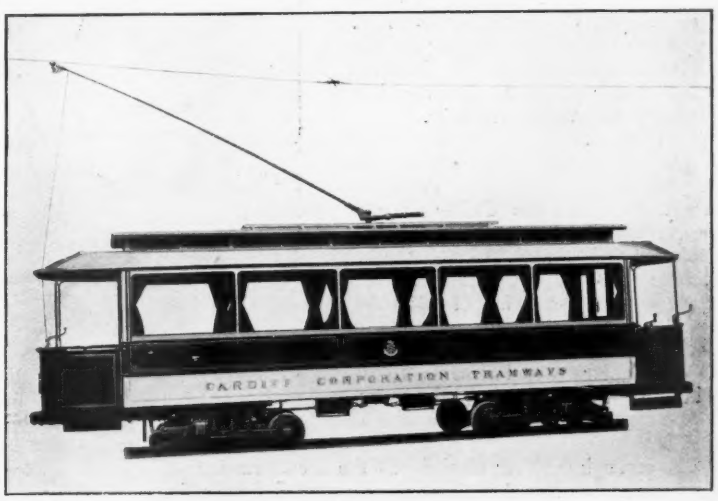
A complete set of engine room signalling apparatus is fixed, controlled from the switchboard gallery, there being three illuminated signal boards at different points of the room—one at either end, and one below the central gangway.

Cardiff is an ideal town for tramways, being practically flat; there are only four gradients in the whole system, the worst of which is 1 in 20. On the other hand, the tramways are handicapped to some extent by very low railway bridges, necessitating the reduction of head room inside the cars, and on two routes the use of single-deck cars. Fortunately, on the main route to the docks, where most of the cars run, it has been possible to lower the roadway 15 in., giving sufficient headroom under the bridge on this route for the use of double-deck cars. The sharpest curve on the system is of 40 ft. radius.

Girder rails have been used, having a weight of 100 lbs. per yard. The rails are 45 ft. long and $6\frac{1}{4}$ in. in depth, with a 7 in. flange; the groove of the rail is $1\frac{1}{4}$ in. wide ×



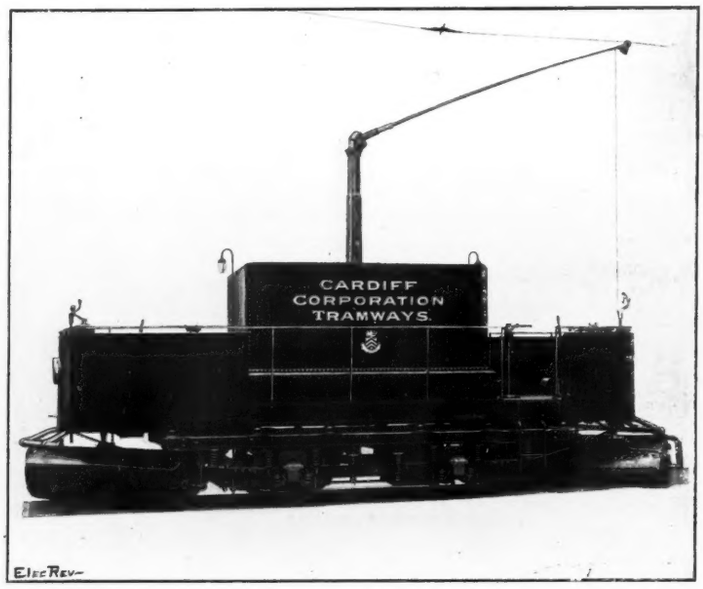
Double-Deck Single Truck Car.



Single-Deck Bogie Car.

1¼ in. deep. The rails are laid on a concrete bed 11 in. deep and 18 in. wide, the depth of concrete under the other portions of the track being 8 in.

The rail joints are made by fishplates weighing 64 lbs.



ELECTRIC SWEEPER.

per pair, with six 1-in. bolts and patent lock nuts. The joints are further secured by soleplates, 2 ft. × 11 in., ½ in. thick, secured by four single and two double clips, with ¾ in. bolts and nuts. The tie bars used were specially designed by Mr. Harpur, the borough engineer.

The depth of the rails being 6¼ in., and that of the paving bricks only 4 in., enables the rails to be buried in concrete to a depth of 2¼ in.

The first batch of rails was supplied by Messrs. Dick, Kerr & Co., and the second by Messrs. Bolckow, Vaughan and Co., of Middlesbrough. The points and crossings were supplied by Messrs. Askham Bros. and Wilson and Messrs. Hadfield, both of Sheffield.

The track is paved almost entirely with wood blocks, with composition blocks between the tracks, where centre poles are used. The wood blocks are Jarrah wood and redgum; the timber is delivered in bulk, and cut up into blocks at the Corporation's saw mill. To reduce the wear and tear on the wood blocks at the sides of the rails, chilled iron paving blocks are laid alternately with the wood blocks.

The track construction was commenced on the new routes in December, 1900, the work being done for the Tramways Department by the Public Works Department of the Corporation.

The lines belonging to the Cardiff Tramways Company, Limited, were purchased for the sum of £50,000. The Corporation also took over 52 cars and 342 horses, for which they paid £15,644. There still remains to be paid to the company the sum agreed upon for the purchase of three depôts.

The borough engineer carried out the reconstruction of the lines, and on May 1st 11 miles were opened for traffic, whilst the whole of the 12 miles was completed on May 16th, in one month less than the time guaranteed.

The track is double-bonded at each joint with a Chicago and Plastic bond, Neptune bonds also being used; it is cross-bonded every 80 yards.

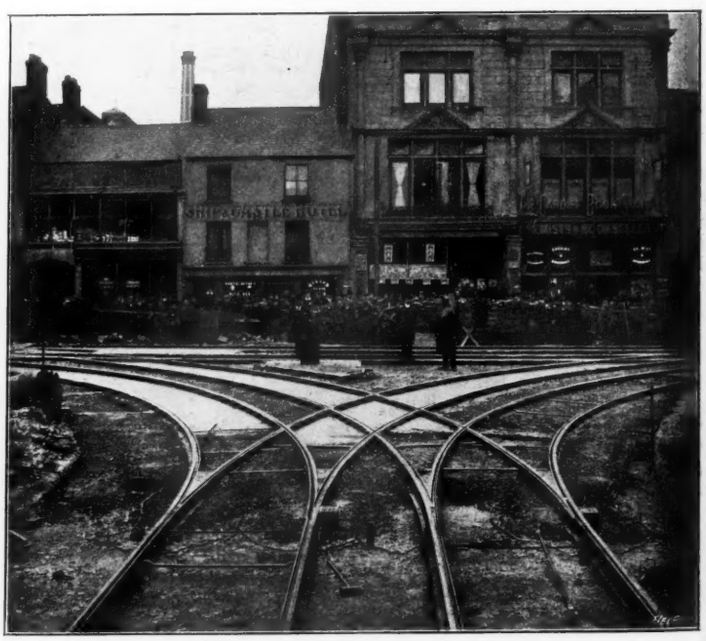
The whole of the overhead equipment, as well as the bonding, has been carried out by the men of the tramways department under Mr. Ellis, the poles, brackets, bases, &c., being also designed by him. The equipment is very solid and substantial; flexible suspension is used throughout.

Centre poles are used chiefly, but side poles with bracket arms and span wire construction are used on some of the routes, where the streets are not sufficiently wide for centre poles, although double track is laid. Specially heavy materials have been used, including 000 trolley wire, supplied by Messrs. Back and Manson, agents for Messrs. Roebling and Sons. The hangers are made of best gun-metal, with ¾ in. insulated bolts. None of the ears are less than 18 in. long, and they were specially designed by Mr. Ellis to give extra strength; they vary in length up to 36 in. The insulation is of the Aetna type. The line materials were supplied by Messrs. R. W. Blackwell & Co., of London.

The span wire consists of seven strands of No. 12 S.W.G. galvanised steel wire, whilst the guard wires are of 12 No. 16 strands.

Steel taper poles in one section have been used, with heavy cast-iron bases, 6 ft. high. Whilst heavy materials have been used, they do not in any way detract from the appearance of the construction, which is considered to be light and elegant.

Three types of cars are in use, viz., double-deck four-wheel cars with a wheel base of 6 ft., double-deck bogie cars with maximum traction trucks, and single-deck bogie cars with maximum traction trucks, the wheel bases being 4 ft.

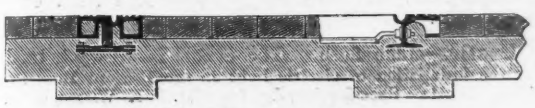


SPECIAL WORK AT TRIANGULAR JUNCTION.

The four-wheel cars carry 52 passengers each, 22 inside and 30 outside. The staircases are of the double or broken type, with a platform half way up. The overall length of these cars is 28 ft. 6 in. over the collision fenders, with platforms 5 ft. 9 in. The internal length of the car body is 16 ft.

On account of the low bridges, the overall height of the cars from the rails to the trolley plank is 9 ft., in order to leave 6 ft. clearance from the trolley plank or upper deck to the underside of the bridges. On this account it has only been possible to get an internal headroom of 6 ft.

The double-deck bogie cars are similar in every way except in length, the overall length over collision fenders



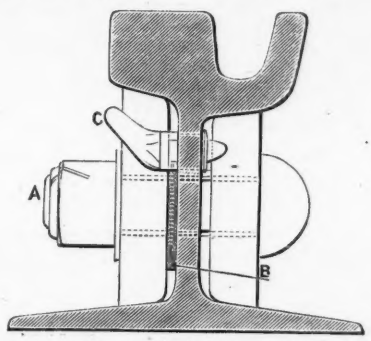
Cross-Section of Track.

being 34 ft. 6 in., and inside car body 21 ft. 4 in. The roof seats are in both cases of the garden type. They carry 68 passengers—30 inside and 38 outside.

The single-deck bogie cars carry 34 passengers each, and the length over collision feeders is 33 ft. 6 in.; the internal length of the car body is 24 ft. 4 in., the platforms at either end being 3 ft. 9 in.

The internal finish of the three types of cars is very handsome, the double-deck cars having flat roofs, whilst the single-deck cars have clerestory roofs. The woodwork is chiefly light and dark oak, and the ceilings three-ply bird's-eye maple, divided into panels by oak mouldings. All inside seats are lath and space, no cushions being used. It may be added that all the cars have steel under-framing.

The lighting of the cars is also done on a generous scale. The double-deck bogie cars have eight 16-c.p. lamps inside,



A, Patent lock nut; B, Plastic bond; C, Copper bond.

Cross-Section of Rail.

with two roof lights, and the usual dash and canopy lights, &c. The four-wheel cars are similarly lighted, with the exception of there being only six internal lights of 16 c.p. The single-deck cars have eight internal lights.

All the cars are provided with illuminated distribution or route indicators, made by the British Electric Car Company, of Manchester. Each car has also a ruby leakage lamp at either end.

(To be concluded.)

ELECTRIC TRACTION NOTES.

(*Continued from page* 982.)

Salford.—A third fatality last week proved the inadquacy of the life-guards on the electric cars. It is expected that within a short time all of the cars will be equipped with an improved form of life-guard invented by the tramways manager, Mr. E. Hatton.

Singapore.—The Straits Legislative Council have passed a Bill for the introduction of electric tramways in the capital.

South Africa.—The *Cape Argus*, in congratulating Durban upon the initiation of its system of electric tramways, which have involved the expenditure of a quarter of a million of money, the financial success being a foregone conclusion even at minimum charges, says it is an object lesson too late for Cape Town, but should be invaluable to Kimberley, Johannesburg, Bloemfontein, and other large centres of population where electric tramways are looming ahead.

Southport.—In addition to the annual report of the Southport Electricity Estate, which shows a net profit of £1,682, the annual report of the Tramways Estate is now published, and shows a net loss of £40. The proportion for repairs and renewals is ·19d. per car-mile, compared with ·21d. at Bradford. In Southport the salaries are ·17d, compared with ·25d. at St. Helens. The great drawback to the Southport Electricity Estate is the amount of money required for interest and sinking fund. At Southport the capital expenditure amounts to £162,811, a sum of £27,165 having been added during the past year. Whilst the gross profit on a capital expenditure of £162,811 is £10,704, or 7·24 per cent., the net profit is £1,682, or only 1·04 per cent. The great increase in the year is in the supply for trams, which accounts for 43 per cent. The ordinary consumers have accounted for an increase of 9 per cent. in the units sold. The cost of running the trams is £9,500; the interest and sinking fund require £6,200, with the result that the gross income for the year of £16,018 is £122 less than the gross expenditure and interest, and even allowing the £81 profit which the trams made in the first nine months, there yet remains a deficit for the year of £40. There are at present 26 electric cars and two horse cars available for the service. Three of the new cars are fitted with the Tidswell patent life-guard, and one with the Newton patent life-guard.

Wolverhampton.—Our local correspondent says that the line from Queen Square to Newbridge (Tettenhall) has now been completed. Trial trips were made on Saturday and on Sunday, and they were highly successful—the distance outward and homeward being covered without a hitch. It is the subject of general comment that nearly every "box" on the line from Ettingshall Road to the Exhibition has, during the past fortnight, been opened, and something done at them. Quite an army of men have been seen engaged in the early morning and during the day at this work, first passing along one line and then the other. The proceedings are watched with curious interest, and the question naturally asked is: "Who pays for all this?" At a recent meeting of the Tramways Committee there was a notice on the agenda which, if carried, would have empowered Mr. Shawfield, the borough electrical engineer, to make certain alterations to the skate on the electric cars, with the object of improving the same. This led to an animated discussion. General Manliers felt that if the engineer were allowed to interfere with the cars or the skates during the test, it would be equivalent to the Corporation violating the contract with the Lorain Company, and committing the Corporation to an acceptance of the system. This being so, the legal aspect of the question was referred to the town clerk for his consideration. At the Council meeting on Monday, the town clerk submitted Col. Yorke's report on his inspection of the lengths of line from Bilston Road to Coleman Street. The inspection took place on April 26th. The Inspector says:—

> The tracks, including the surface contact boxes, are well laid and in good order. The mode of construction has already been fully described by me in my report dated January 20th, 1902, and it is unnecessary for me to repeat the description.
>
> The remaining portions of the tramways referred to in letter from the Corporation, dated March 25th, have not yet been completed so far as the electrical equipment is concerned, and I therefore did not inspect them.
>
> The sharpest curve on the route inspected is the corner between Darlington street and Waterloo Road, where the radius of the innermost rail is only 87·6 ft. The steepest gradient is in Queen Square, and has an inclination of 1 in 19.
>
> The interval between the tracks on this curve is increased to 8·2 in., which is sufficient for all cars except those fitted with the American life-guard, to pass each other with safety. But so long as the American life-guard remains it is desirable that cars shall be prohibited from passing each other on this curve.

The colonel makes a number of recommendations as to stopping places and as to speeds, and then proceeds:—

> The cars have already been described by me in my report of January 20th, but the Corporation are now fitting the cars with the Wilson and Bennett life guard, which is satisfactory.
>
> The experience of the Lorain system gained so far in the section already opened for traffic is encouraging. No accidents have occurred, and improvements in the details of the apparatus have been introduced.
>
> Subject, therefore, to the restrictions of speed, and the conditions already enumerated being observed, I can recommend the Board of Trade to certify the tramways as fit for traffic for a period of 12 months.
>
> I also had my attention drawn to two short lengths of tramway in the nature of sidings in Lichfield Street and Coleman Street. These are not authorised by the Act of 1899, and cannot therefore be certified, but I see no objection to them.

Stirling.—The following suggestive note has been sent to us by our Stirling correspondent:—"In the neighbourhood of the town of Stirling, one of the most popular tourist resorts in Scotland, full of historical interest and association, there is at present a fine field for the introduction of an electric tramway system. At present the towns of Stirling and Bridge of Allan on the north side are connected by a horse tramway, but to the south side of the town, in which there is the village of Bannockburn and a rapidly growing district immediately beyond, there is no railway accommodation, and only a very limited service of 'buses. In this neighbourhood the coal industry has increased of late with astonishing rapidity, and there are prospects that in the near future mining operations will be carried on to a still greater extent. For this large and increasing population, Stirling is the centre, and within easy reach. The route will be greatly improved immediately by the construction of a new highway which the Corporation of Stirling has already commenced. The existing tramway stops where this new road begins on the Stirling side, and runs from that point to Bridge of Allan, a distance of about 3½ miles. The Town Council of Stirling have the option of purchasing the portion of this line lying within the burgh, and as they may now take advantage of this option, the present is a very favourable opportunity for arranging with the local authorities. The route from Bridge of Allan to the new district beyond Bannockburn covers a distance of about seven miles, and there is almost a continuous range of residences along the whole route. As to the supply of power, there need be no difficulty in arranging with the Corporation of Stirling, whose electrical

power station is situated about midway between the extreme points of the suggested tramway system. The plant is of modern construction, and a large extension now being completed is designed with a view to the supply of energy for tramway haulage. The whole position is of very great importance to tramway syndicates, and no doubt full information would be got through the town clerk of Stirling."

TELEGRAPH AND TELEPHONE NOTES.

Anglo-French Telephones.—An agreement has been made between France and Great Britain for extension of telephonic communication between the two countries. It will be possible henceforth to telephone between all the large cities in the two countries.

Bournemouth Telephones.—A special committee has been appointed to consider the question of a municipal telephone service for the borough.

German Atlantic Cable.—The result of the working operations for the year 1901 of the German Atlantic Telegraph Company, shows after meeting expenditure and providing for depreciation, a surplus of £60,491, as compared with £28,089 in 1900. It is proposed to pay a dividend at the rate of 4½ per cent. on the paid-up capital, as against 2 per cent. in the preceding year. The board of supervision will submit a proposal at the general meeting to be held on the 30th inst. to raise £1,000,000 by the issue of 4 per cent. bonds, in order to provide the means for the construction of a second cable.

Persian Telegraphs.—The Persian Government has begun erecting the new telegraph from Meshed to Birgand.

South African Cables.—The Eastern Telegraph Company, Limited, notified that the shore end of the interrupted cable at Cape Town was temporarily restored on May 31st, since which date there had been no delay to Cape Town. The landlines in Cape Colony were, a week ago, stated to be in thorough working order, and as the repairing steamer had arrived at Cape Town, the temporary repair of the shore ends of the cables was to be made permanent.

Telegraph Wire Export Trade.—So far as the year has gone, the export trade of the country in telegraph wire and apparatus connected therewith has been remarkably quiet. The shipments during the past month only reached a value of £36,423, which compares with £245,333 in the corresponding period of last year, and £395,808 in May, 1900. For the five months ending with May. the exports have only amounted in value to £840,319 as contrasted with £1,623,312 in the corresponding five months of 1901.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Puerto Plata-Martinique	May 30, 1902 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
St. Lucia-Martinique	May 7, 1902 ..	..
St. Lucia-St. Vincent	May 7, 1902 ..	..
St. Lucia-Grenada	May 7, 1902 ..	..
Dominica-Martinique	May 5, 1902 ..	..
Guadeloupe-Martinique	May 5, 1902 ..	..
Hong Kong-Manila	June 3, 1902 ..	June 10
Landlines :		
Route *via* Hanekin on Persian territory ..	.. Feb. 24, 190 ..	..
Communication with Tientsin and Taku *via* Helampo	.. June 18, 1900 ..	..
All lines Siberian Michailo - Semenowskol - Lougowaia	.. June 8, 1902 ..	June 9

Tunbridge Wells Telephones.—It is stated that the L.G.B. has sanctioned the Council's proposed £15,000 loan for extensions to the telephone system.

Wireless Telegraphy.—A telegram from New York states that the Marconi Company has completed its new station at Bridgehampton, Rhode Island, and expects to complete the primary station at Cape Cod, and be ready for despatching wireless messages across the ocean by June 22nd.

The American Steamship Line are installing Marconi wireless telegraphy apparatus on the *St. Louis* and the *St. Paul.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—September 1st. The municipal authorities of Klausenburg (Kolozsvar), Siebenbürgen, are inviting tenders until September 1st, for the establishment in the town of a central station for electric lighting and power purposes. Tenders are to be sent to Bela Fekete Nagz, Kolozsvar, from whom particulars may be obtained.

Bermondsey.—June 16th. Main switches, cut-outs, distributing boards, electrical fittings, shades, conduits, &c. See "Official Notices" May 30th.

Birkdale.—June 14th. Wiring of the Town Hall and fire station. Particulars from J. F. Keeley, accountant to the U.D.C.

Blackpool.—A year's supply of carbons for the electricity works. See "Official Notices" to-day.

Bootle.—June 20th. The School Board wants tenders for the installation of electric light in the Bedford Road Board School, Bootle. Specification, &c., from Mr. F. K. Wilson, clerk.

Bournemouth.—June 23rd. Station and car depôt lighting and wiring motors, also testing instruments and accessories for the Corporation tramways. See "Official Notices" to-day.

Bristol.—June 20th. Pumps, water softener, filters and pipework for the electricity department. See "Official Notices" June 6th.

Bury.—June 24th. Construction of permanent way for tramways. Particulars from Mr. A. W. Bradley, borough engineer and surveyor.

Chili.—The Chilian Government proposes to construct a cable connecting Punta-Arenas and Puerto-Montt. Particulars concerning the proposed undertaking can be had by those interested from the Chilian legations in the various capitals.

Genoa.—June 20th. The *Times* says that the Board of Trade have received through the Foreign Office a despatch from his Majesty's Consul-General at Genoa, notifying that tenders will be received up to 11 a.m. on the 20th inst. for the supply of electric lanterns and lamps for use on board Italian warships, to the estimated total value of 39,823 lire (about £1,555), to be delivered at the Royal Arsenals of Spezia, Naples, Venice and Taranto. Tenders will be opened simultaneously at the General Directorates of the Royal Arsenals above mentioned, a deposit of 3,980 lire (about £155) being required to qualify any tender. A copy of the specification, together with a translation thereof, may be seen on application at the Commercial Intelligence Branch of the Board of Trade, 50, Parliament Street, S.W.

Hungary. — September 1st. The authorities of Kolozsvár, in Hungary, want to introduce electricity for lighting and power purposes. See "Official Notices" May 9th.

Ipswich.—July 5th. Engines and dynamos, storage battery, overhead hand travelling crane, feeders, mains, &c., permanent way construction, and arc lamps. See "Official Notices" June 6th.

Launceston (Tasmania).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Leigh.—The electrical engineer to the Corporation has been instructed to obtain tenders for the supply during the year ending June 30th, 1903, of electricity meters; electric motors; house service boxes; manhole frames and covers; and 22 yds. of ⅞ house service cable.

Little Woolton.—June 20th. Laying and jointing of cables, supply and fixing of junction boxes and lamp connections, and supply of lamp fittings. See "Official Notices" June 6th.

London, S.W.—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

Manchester.—June 14th. Line materials for overhead equipment, trolley wire, &c. See "Official Notices" June 6th.

Nuneaton.—June 18th. One water-tube boiler and connecting pipework. See "Official Notices" May 30th.

Romford.—June 30th. The U.D.C. wants offers for the construction and maintenance of electricity supply works. See "Official Notices" to-day.

Rotherham.—June 17th. Tramway and lighting feeders, mains, &c., Lancashire boilers, and steam dynamo. See "Official Notices" May 30th.

Stalybridge.—July 7th. Three 500-kw. steam-driven three-phase alternators; three 50-kw. continuous current exciters; permanent way, bonding and cable conduits for the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board. See "Official Notices" to-day.

Stockton-on-Tees.—June 17th. Boilers, condensing plant, steam dynamo, switchboard, mains, &c. See "Official Notices" May 30th.

Stretford.—June 18th. Tenders wanted for boilers, superheaters and economisers, steam dynamos, condensers, pumps and mains. See "Official Notices" May 23rd.

Sunderland.—July 10th. Permanent way, overhead equipment and cables for the Corporation tramways department. See "Official Notices" to-day.

Sydney.—July 23rd. Complete system of high and low pressure cables, and of arc lamps for street lighting, for the Municipal Council. See "Official Notices" to-day.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

Warrington.—June 18th. Tramcars, with electrical equipments. See "Official Notices" May 30th.

Wellington (Salop).—June 25th. The U.D.C. invites applications for a lease of its electric lighting powers. See "Official Notices" June 6th.

West Ham.—50 double-deck electric cars with equipments, for the Council. See "Official Notices" June 6th.

Worksop.—June 17th. Low tension cables and joint boxes for the U.D.C. See "Official Notices" June 6th.

CLOSED.

Belfast.—The following is a list of the tenders sent in for lighting the Scottish Provident Buildings. Mr. John Woodside is the consulting engineer:—

L. B. Mollan & Co.	£560	0	0
National Electric Wiring Company, Limited	558	10	0
Gilmore & Co.	541	0	0
Richard Patterson & Co.	510	0	0
Stanley Johnston	432	0	0
William Coates & Son, Ltd. *(accepted)*	430	0	0

Blackburn.—The tender of Messrs. Dick, Kerr & Company, for the supply of steam dynamos, with engines by Messrs. Willans & Robinson, has been accepted at a sum of £18,137.

Carnforth.—The Carnforth Hæmatite Iron Company have decided to instal one of Messrs. Willans & Robinson's standard compound engines for direct coupling to a Mather and Platt dynamo, for supplying power to their works.

Chesterfield.—The British Westinghouse Electric and Manufacturing Company, Limited, have just received an order from the Bolsover Colliery Company, Limited, Chesterfield, for a complete polyphase electric power installation. The power will be used principally for hauling and pumping purposes in the colliery workings.

Glasgow.—The Corporation have accepted the tender of the British Thomson-Houston Company, Limited, for switchboard extensions (lighting) at Coplawhill tramways sub-station for the sum of £933. The highest tender was about £1,300.

Liverpool.—The Corporation have accepted the tender of Messrs. Willans & Robinson, Limited, for three 1,500-H.P. engines for direct coupling to Siemens dynamos. The firm have also received an order for three 1,500-H.P. engines from the B.T.H. Company for direct coupling to three-phase alternators, also intended for the Liverpool Corporation.

Liverpool.—The Forest City Electric Company have received the contract from the British Westinghouse Electric and Manufacturing Company, for the copper bonds, and hydraulic bonding tools, for the Mersey Railway.

London.—The London County Council received the following tenders for the wiring and fitting of the Euston Road fire brigade station:—

D. Assersohn *(accepted)*	£268	10	0
Lawrence & Co.	323	0	0
Jackson Bros.	352	3	6
W. Mossop & Co.	357	0	0
C. Cooper & Co.	375	10	0
A. Goldsmith & Co.	400	0	0
Wakelin & Co.	597	0	0

The undernoted prices were submitted for making a trial boring for water at the power station to be erected at Greenwich, the depth of the boring being assumed at 300 ft.:—

Le Grand and Sutcliffe *(accepted)*	8½ in. bore hole	£310
Merryweather & Sons	9 in. „ „	395
C. Isler & Co.	10 in. „ „	545
Dowcra & Co.	9 in. „ „	592

South Wales.—The South Wales Electrical Power Distribution Company have accepted the tender of Messrs. Willans and Robinson, Limited, for three engines of 3,000-H.P. each, and for several of smaller size for their Pontypridd station.

Wallasey.—The Tramways Committee has accepted the tender of Messrs. Dick, Kerr & Co. for five cars at £571 each, and a combined track sweeper, water car and detachable snow sweeper, at £660.

FORTHCOMING EVENTS.

Friday, June 13th.—At 3.30 p.m. Physical Society. Meeting at the National Physical Laboratory, Bushy House, Teddington.

At 9 p.m. Royal Institution. Extra Friday evening discourse will be delivered by G. Marconi, M.I.E.E., on "The Progress of Electric Space Telegraphy."

Saturday, June 14th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. General meeting to be held in the Wood Memorial Hall, Newcastle-upon-Tyne.

At 8 p.m. Grand Bohemian Concert of the Electrical Trades Union, at Finsbury Town Hall, Rosebery Avenue, W.C.

NOTES.

Our June 27th Issue.—We shall be glad if all our readers, contributors, advertisers, and other friends will take special note of the fact that, in consequence of Coronation Holidays, our issue for Friday, June 27th, will appear on Wednesday morning, June 25th. All material intended for that issue should be in our hands two days earlier than usual.

The American Pacific Cable Scheme.—The Central News says that the House of Representatives has rejected by 108 to 71 the Bill enabling the Government to construct a trans-Pacific cable

The Fire at the G.E.C.—We tender to the General Electric Company, Limited, and to the relatives and friends of all those humble workers who lost their lives or who suffered in any way through the terrible catastrophe which occurred at 67, Queen Victoria Street, E.C., on Monday afternoon last, our most sincere sympathy. As to the actual cause of the fire nothing is officially announced as yet. There have been 10 deaths, the majority being due to suffocation, but many persons were injured either from that cause or through jumping from the fourth floor window. It is a hard thing to have to write, but there is little doubt that most, if not all, of the victims might have been saved but for the shortcomings of the Fire Brigade authorities, who had not a sufficiently long escape at hand.

We are asked to publish the following letter:—

Dear Sir,—The General Electric Company (1900), Limited, wish to express their unqualified regret at the terrible results which attended the fire at their premises on Monday the 9th inst., and to state that they are taking steps to give this sentiment practical shape.

They would also like to take this opportunity to convey to their friends and customers their thanks for the many expressions of sympathy received in letters, telegrams and personal inquiries, and to inform them that the part of their premises which was involved is small. Business will be carried on exactly as before, and it is hoped that if at first one or two delays may have occurred, the firm will receive indulgence on this account.

Hoping you will give this letter publicity,

Yours faithfully,

THE GENERAL ELECTRIC COMPANY (1900), LIMITED.

M. BYNG, *Managing Director.*

We understand that the Fire Brigade of the G.E.C. were playing on the fire within less than one minute after receiving knowledge of the outbreak. Their efforts were doubtless of great value in keeping the fire from assuming even more serious proportions, and they were only relaxed upon the appearance of the regular Fire Brigade. The inquest is to be held in a few days, and in the absence of definite knowledge as to the cause of the outbreak, we refrain from any further comment.

When questions as to this disaster came before the L.C.C. meeting on Tuesday, the chairman of the Building Act Committee said, according to the *Times* of Wednesday, that no certificate of the sufficiency of the means of escape from these premises in case of fire had been granted. He was informed that two buildings were involved. On the second and third floors of the building burnt there were about 20 persons. On the fourth floor the number would be about 20 also. On the fourth floor there was no communication between the eastern and western building. It was not a new workshop, and was not on the Home Office factory list, and had not been inspected by the officers. No particular attention had been called to this building. The ground and first floors were in the occupation of a shipping firm, which did not employ many people, whilst the second, third, and fourth floors were occupied by the electrical company; and in buildings of this class, where there were two separate occupants, the difficulties of providing means of escape from fire were greater than in ordinary cases.

Municipal Electric Launches.—An evening paper says that the L.C.C. has revived its project for the establishment of a fleet of electric launches on the River Thames. It is proposed that there should be a service at 15 minutes' interval all the year round between Hammersmith and Greenwich. The fleet will consist of 30 boats, and the capital expenditure (including the acquisition and improvement of the piers) is put down at £328,000. The annual cost of maintaining the service is estimated at £98,960.

Obituary.—We regret to have to record the death of Mr. Wilfred D. Bailey, A.M.Inst C E., M.I.E.E , and M.I M.E., which took place at Buenos Ayres on December 1st last. Mr. Wilfred D. Bailey, who was born on February 15th, 1867, was the fourth son of Mr. John Bailey, who began his connection with Messrs. Silver and Co., in 1848, and who, as resident manager of the Silvertown Works for over forty years, has been so intimately associated with their growth from very small beginnings to their present vast manufacturing output. In the engineering shops at Silvertown young Wilfred D. Bailey, after leaving school, served five years' apprenticeship, qualifying himself in the various branches of civil engineering. In 1888 the subject of this notice went out to Buenos Ayres as assistant at the India-Rubber Company's branch in that town. The post afforded scope for turning to account his engineering education, and also gave him an opportunity for acquiring a thorough knowledge of business. Mr. Wilfred D. Bailey served seven years in this position, and then in 1895 set up on his own account in conjunction with Mr. L. Walker as electrical and general engineers, under the style of Bailey, Walker & Co. His early engineering training at Silvertown, combined with the business experience gained in the company's agency, were now of great service to him, and the firm soon acquired a leading position in its particular branch of industry. There was every prospect of a highly successful future, when following shortly on his partner's death Mr. Bailey himself contracted typhoid fever, and after three weeks' illness, though considered convalescent, suffered a relapse and died. At the time of his death Mr. Wilfred D. Bailey had only reached the age of 34, and the popularity of his genial and kindly character was attested by the number of friends—close upon 200—who assembled at his funeral, and by whom his loss will be deeply felt. The deceased leaves a widow, but no children.

By the death of Sir Daniel Cooper this country has lost another of its distinguished Colonial statesmen and an interesting personality. For many years past he had occupied the position of chairman of the Electric Construction Company, Limited, of London and Wolverhampton. Death occurred at Sir Daniel's London residence, and in his 81st year.

Personal.—Mr. J. W. Kempster, on leaving Messrs. W. H. Allen, Son & Co., Limited, Bedford, where he has been chief electrician for 14 years, to take up a similar position with Messrs. Harland & Wolff, of Belfast, has been presented by the members of the firm with a collection of Sheffield plate over 100 years old, while from the staff he received two etchings by Rone. During his connection with Messrs. Allen, Son & Co., Mr. Kempster has had 280 vessels in his hands for installing electric light, including the *Oceanic* and the *Celtic*.

The Kimberley Borough Council has selected from 14 applications for the appointment of electrical engineer, Mr. J. M. Lambe, of Rondebosch, at present chief assistant electrical engineer to the Cape Peninsula Lighting Company.

We read in an exchange that Mr. Robert Miller, of Wellington, N Z., has been appointed electrical engineer for the Gore Borough Works in Southland.

According to the *Daily Mail*, the Accademia dei Lincei, of Italy, has decided to give Mr. Marconi a prize of £400 as a reward for his improvements in wireless telegraphy.

Mr. Arnold G. Hansard, A.M.I.E.E., after many years of service with the Brush Electrical Engineering Company, during which time he has held various responsible posts, including the directing of traction contracts, and formerly the direction of all their electrical designing (in succession to Mr. W. M. Mordey), has now left them to take up consulting work. He has taken an office at 92, Victoria Street, Westminster, S.W.

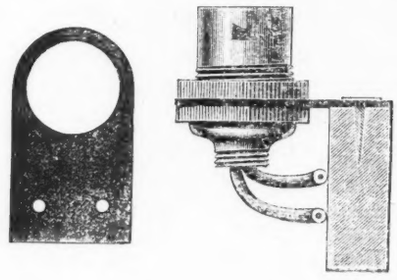
Appointments Vacant.—A teacher of electric lighting and power transmission is wanted for two nights a week at the Acton and Chiswick Polytechnic, Bedford Park; half a dozen permanent way inspectors are wanted by the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board; shift engineer (£125) for Blackpool electricity works; station superintendent (£175) for Blackburn works; five assistant superintendents in the Indian Government Telegraph Department, at Rs. 4,200 per year.

Institution of Electrical Engineers.—Mr. Balfour has appointed the hour of 12, noon, on Wednesday, 18th inst., for receiving the deputation on the subject of electrical enterprise, at the offices of the Board of Trade.

Electrical Trade Section of the London Chamber of Commerce.—At the annual meeting of the London Chamber of Commerce held on Tuesday at the Cannon Street Hotel, Lord Brassey in the chair, the report, which was adopted, stated that 18 meetings of the Electrical Trade Section and its committees were held during the year in connection with a number of important questions affecting the electrical industry. The report of the matters dealt with was referred to in these columns a few weeks ago.

E.E.R.E. (V.).—According to the new volunteer regulations, the volunteer electrical engineers are required to put in 18 attendances during the first year and in every subsequent year until qualified. The obligation on qualified men is 18 attendances for those who are in camp annually for only six days, and six attendances in other cases. Unqualified men may go into camp for eight days continuously or two periods of four days each, and in the case of qualified men six days. A volunteer of the Corps of Electrical Engineers will not be deemed efficient unless he possesses a competent practical knowledge of at least one of the electric lighting subjects specified in the regulations.

Illumination Device.—An extremely neat and economical attachment has been devised by Mr. W. A. Walton, London Road, Gloucester. The sketch explains itself; a plain iron stamping screwed to a batten is used, in conjunction with a lampholder which is attached to the stamping by means of the shade-carrier. The point is that the lampholder is "good stock," and can be sold after use.



L.C.C. and the Retention Money Under Contracts.—The General Purposes Committee stated at Tuesday's meeting of the L.C.C. that the engineer had drawn attention to the inconvenient operation of Standing Order 200 in the case of contracts for machinery. This standing order, which deals with payments under contracts, is as follows:—"In the case of contracts not exceeding £100,000, instead of requiring the contractors to furnish sureties for the due performance of their contracts, payments should be made at the rate of 80 per cent. of the value of permanent work executed, until the amount due in respect of the contract, and remaining unpaid, shall be equal to 10 per cent. of the amount of the contract price; after which the full value of the further work certified by the superintending officer shall be paid. In the case of contracts of £100,000 and upwards, special arrangements shall be made. Certificates shall be given by the superintending officer not oftener than once a month. One-half of the retention money shall be paid on completion of the work, and the balance at the expiration of the period of maintenance." The engineer pointed out that in the case of machinery the work could not properly be considered as "permanent" until it had been delivered, erected and tested; in other words, until the contract was completed. This meant that a contractor would have to spend very large sums of money before he received any advance whatever on account of work done, and probably many firms would be hindered from tendering. It was, therefore, proposed by the Committee that payments under contracts for machinery should be made as follows:—50 per cent. on delivery, 25 per cent. after the machinery has been erected, 15 per cent. after trial or test, and the balance after the expiration of the prescribed period of maintenance. A recommendation to this effect was carried.

A Scandal which Everybody Admits.—In the evidence given on Electrical Legislation before the Committee of the Institution of Electrical Engineers, Lieut.-Colonel Crompton expressed some strong opinions upon the municipal consulting engineer fraternity when he said, "It was a matter of common knowledge that a very large number of junior and ill-educated men are acting as consulting engineers, and doing our industry a great deal of harm. Men who left us as pupils, and who were failures in everything, blossom out into consulting engineers, and gradually have a large number of towns to do. This is a scandal which everybody admits, and yet it cannot be avoided so long as these towns must employ their own consulting engineers." It would be interesting to learn whether these "failures in everything" were retained in the Arc Works during the full term of their pupilage. If so, why? The gallant officer's remarks reflect seriously not only upon a certain number of his old pupils, but upon his own company, and should not be allowed to pass unnoticed.

Frogs and Telegraphs.—Something new in the relations between "galvanic" telegraphs and frogs is reported as follows:—One of the great enemies of the overland telegraph line in Central Australia is the common green frog. In order to save the insulators from being broken by the lightning, they are provided with wire "droppers" leading round them at a little distance, to conduct on to the iron pole in case of need. The frogs climb the poles, and find the insulators cool and pleasant to their bodies, and fancy that the "dropper" is put there to furnish them with a back seat. After a nap they yawn and stretch out a leg until it touches the pole—result, sudden death of the frog, and as the body continues to conduct the current to earth, we have a paragraph in the papers to the effect that "in consequence of an interruption to the lines, probably caused by a cyclonic disturbance in the interior, we are unable to present our readers with the usual cables from England."—New York *Electrical World*.

Overhead Wires.—The *Bombay Gazette* says that owing to several accidents having occurred on account of the breaking of overhead electric wires, the Bengal Chamber of Commerce and the Calcutta Trades Association are taking steps to petition the Government of Bengal to compel the Electric Supply Company to place their cables under ground.

Institution of Junior Engineers.—The summer excursion of this Institution, which is arranged for August 9th to 16th, will include visits to the works of the English Electric Manufacturing Company, and the Electric Railway and Tramway Carriage Works Company, at Preston, the Electric Railway from Blackpool to Fleetwood, Messrs. Vickers, Sons & Maxim's Works at Barrow-in-Furness, and several other interesting items. Members' friends will be allowed to take part in the excursion.

The Schmidt Highly Superheated Steam System.—On Tuesday, 10th inst., a party of about 200 engineers and others went down to Erith by special train to see the triple-expansion engine working with highly superheated steam at the works of Messrs. Easton & Co. The engine is one of the firm's standard high speed type with three lines of tandem cylinders, including one H.P., two I.P., and three L.P. cylinders. The first three cylinders are 12 in. diameter, the others being 16 in. diameter; the stroke is 8 in. The cylinder ratios are thus 1 : 2 : 5½. Steam superheated to 700° F.—it was at 650° at the time of the visit—is admitted to the engine, but passes, on its way to the H.P. cylinder, the exhaust of the I.P. cylinders. It is thus slightly cooled, and superheats the steam for the L.P. cylinder to about 350° F. It is claimed that this high superheat enables one I.H.P. to be produced for 1·18 lbs. of coal, and in tests made on the engine as little as 18·3 lbs. of steam per electrical unit has been found. We hope to have a fuller description of the engine and system in the near future. In addition to the engine, a superheater was shown erected in the yard. After luncheon the party returned to London, some by train and some by a special steamer, which was considerably delayed by the breaking down of the engine connecting rod big end bolt, just the very second after the engineer had stated to a visitor that "this here engine never has broken down." The delay was rather welcome, as it was pleasant on the river, but the special train must have been at Charing Cross nearly as soon as the steamboat arrived at Westminster. Superheating is gradually compelling attention to its advantages, and licenses for working the Schmidt system are being taken up very considerably, notably by the following firms:—Bow, McLachlan & Co., Paisley; Jas. Carmichael & Co., Dundee; Browett, Lindley & Co., Patricroft; Fairbairn, Lawson, Combe, Barbour, Ltd., Belfast; J. & E. Hall, Dartford.

Superposed Current Transmission.—At a recent meeting of the German Electro-Technical Society at Frankfort-on-Main, Prof. Arnold, of Karlsruhe, read a paper on the so-called Poly-Cycle Distributing System. In alternating power transmission plants which are intended to supply current for both lighting and power purposes, it is frequently difficult to decide upon the correct number of phases and frequency. For lighting purposes a high frequency is necessary, while for single and polyphase motors and transformers a low one is preferable. Were it possible to make a selection, one would choose a single-phase current for lighting and a polyphase one for motors, and, on the other hand, a higher voltage for the motor work than for lighting. To use a separate conducting system is not advisable on the score of cost, so that a compromise has to be resorted to. The author described a distributing system, by means of which two different currents could be conveyed, independently regulated and employed. The system is based on the fact that alternating currents of different frequencies can be conveyed over the same conductors without interfering with each other. Bedell experimented with the superposition of different currents, but his system had the disadvantage that in conveying the currents to the conductors a considerable amount of inductance was introduced. This disadvantage can be obviated by using non-inductive resistances, or by the direct introduction of the superposed currents in the winding of a generator. It is also possible to convey the superposed currents to the conductors, through induction, by means of simultaneous transformation. The author showed a number of drawings dealing with two or three-phase and single-phase currents on the same conductors. The author claims for his system of superposed current transmission that it permits currents of two different frequencies, one for lighting and one for power purposes, to be transmitted along one set of conductors. The voltage of the current for motor driving, and the voltage drop in the feeders and distributing mains can be greater than hitherto, resulting in an economy of copper in the conductors.

A Swiss Congress.—In connection with the International Congress on Medicinal Electrology and Radiology to be held at Berne from September 1st to 6th, arrangements are in hand for an exhibition of electro-physiological, electro-therapeutical, and radiological apparatus.

Germany.—The German Electro-Chemical Society has changed its title. It will henceforth be known as Die Deutsche Bunsen Gesellschaft für Angewandte Physikalische Chemie (German Bunsen Society of Applied Physical Chemistry).

Reconstruction.—We learn that the shareholders of D. Stewart & Co., Limited, engineers and boiler makers of Glasgow, are being called together to consider a proposal to wind the company up voluntarily for a possible reconstruction.

Royal Society.—At a meeting held yesterday, a paper was read by Prof. E. Wilson on "The Dissipation of Energy by Electric Currents induced in an Iron Cylinder when Rotated in a Magnetic Field."

Marriage.—Mr. Charles Morison Johnston, M.I.E.E., borough electrical engineer of Shrewsbury, was married on June 5th, at Lancaster, to Miss Hilda Margaret Robinson, of Lancaster. The presents included a dining room clock, with inscription and bronze figures, from the Shrewsbury Corporation and the chairman and members of the Lighting Committee, and an aneroid barometer, with inscription, from the staff at the borough electricity works, Shrewsbury.

THE CENTRAL STATION ENGINEER.

THE Broughty Ferry Town Council have offered the appointment of electrical engineer to Mr. JAMES TURNBULL, of Willesden. It is proposed that he shall act under Mr. F. Waddell, the present engineer and manager of the electricity department of the Council.

Mr. J. H. CLOTHIER, of Stafford, has been appointed electrical engineer to the St. Anne's-on-Sea U.D.C.

Mr. E. DEWAR, assistant engineer at the High Wycombe Electric Light Works, has been presented by the staff and employés with a gold chain on his departure from the town.

The Electric Light Committee of the Sheffield City Council has intimated its intention to increase the salary of the general manager and engineer of the electric supply department, Mr. S. E. FEDDEN, from £600 to £700 per annum as from June 1st.

The Rotherham Town Council on June 4th decided to increase the salary of Mr. CROSS, engineer at the electricity works, to £250 a year, and that of Mr. WILLIAMS, assistant engineer, to £120 a year.

NEW COMPANIES REGISTERED.

Thomas Bolton & Sons, Limited (73,864).—This company was registered on May 28th, with a capital of £300,000 in £1 shares, to acquire the business carried on by Thomas Bolton & Sons, at Broad Street Metal Works, Birmingham; Oakamoor Mills, near Cheadle; Froghall, near Cheadle, Staffs.; Mersey Copper Works, Widnes, Lancs.; and Sutton, near St. Helens, Lancs., to adopt an agreement made between T. Bolton and T. A. Bolton (trustees and executors of the will of A. S. Bolton) of the first part, F. S. Bolton, of the second part, F. S. Bolton, T. Bolton, C. B. Toller, G. Rathbone and F. A. Bolton, of the third part, and this is of the fourth part, and to carry on the business of copper smelters, manufacturers of metals of every description, manufacturers of wire, wire rods, tubes and sheets of brass, copper and other metals or alloys, metal rollers, steel makers, ironmasters, engineers, founders, smelters and workers in iron, steel, brass, copper and other metals, electricians, engineers, suppliers of electricity for the purposes of light, heat or power, &c. The first subscribers (each with one share) are:—F. S. Bolton, 14, Ampton Road, Edgbaston, manufacturer; J. Bolton, Lightoaks, Oakamoor, North Staffs., manufacturer; C. B. Toller, Aston Bank, Hawarden, manufacturer; G. Rathbone, Baycliffe, Woolton, Liverpool, manufacturer; Sir G. S. Robertson, 11, Harley House, W., Lieut.-Col. (retired); T. O. Callender, West Heath House, Abbey Wood, Kent, engineer; I. M. Henderby, Warleigh Lodge, Wimbledon, chartered accountant; and F. A. Bolton, Moor Court, Oakamoor, North Staffs., manufacturer. No initial public issue. The number of directors is not to be less than four nor more than seven; the first are F. S. Bolton, C. B. Toller, G. Rathbone, Sir G. S. Robertson, T. O. Callender, I. M. Henderby, and F. A. Bolton. Sir G. S. Robertson is "debenture director." Qualification (except the debenture director, Sir G. S. Robertson, and T. O. Callender, or one of the first directors who is also a vendor), 1,000 ordinary shares. Remuneration of chairman, £500 per annum; of ordinary directors, £250 per annum, with a share in the profits. Registered office, Broad Street Metal Works, Broad Street, Birmingham.

Pekin and North China Electrical Corporation, Limited (73,913).—This company was registered on June 2nd, with a capital of £100,000 in £1 shares, to acquire the business carried on by the Siemens & Halske Actien Gesellschaft, Messrs. Mandl & Co., and the Chinesische Electricitats Gesellschaft M.B.H., or one of them, to carry on the business of electrical engineers, makers of electric plant, contractors, &c., in Pekin or elsewhere in the Empire of China, and to adopt an agreement with the Syndicat du Yunnan, Limited. The first subscribers (each with one share) are:—J. W. Clark, 83, Springbank Road, Hither Green, S.E., secretary; H. A. Pensam, 80, Endlesham Road, Balham, S.W., accountant; E. Hallam, 34, Ashburnham Grove, Greenwich, S.E., clerk; A. G. S. Laurie, 19, Fairholme Road, West Kensington, W., chartered accountant; W. Loughran, 69, Marford Road, Upper Clapton, N.E., clerk; C. Pillow, 100, Henley Road, Ilford, secretary; and H. F. Page, Meadow Bank, Hornchurch, clerk. The number of directors is not to be less than three nor more than seven. The first are A. Adam, Sir H. C. J. Bunbury, P. A. Loeder, and A. W. West; qualification, £250; remuneration, £100 each per annum (£50 extra for the chairman) and a share in the profits, such share not to exceed £5,000 divisible in any year. Registered office, Salisbury House, London Wall, E.C.

Clubbe & Southey, Limited (73,939).—This company was registered on June 4th, with a capital of £2,000 in £1 shares, to acquire any patents and rights relating to devices for measuring liquids, and in particular to acquire from A. W. Southey, the benefit of certain existing inventions, to turn to account such patents and inventions, and to carry on the business of electricians, electrical and mechanical engineers, manufacturers of electrical vehicles and carriages, and electrical machines and apparatus, suppliers of power, traction, light and heat, &c. The first subscribers (each with one share) are:—A. J. McMillan, 17, Tower Royal, Cannon Street, E.C., secretary; L. R. Flick, 15, Vincent Square, Westminster, solicitor; C. A. Denyer, Fernhurst, Windsor, solicitor; H. Parker, 17, Mostyn Road, Brixton, S.W., clerk; F. G. Batchelor, 1, St. Anne's Road, Harrow, clerk; W. M. Bailey, Woodleigh, Forest Hill, S.E., accountant; and D. J. Frith, 3, Waterloo Street, Camberwell Green, clerk. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; remuneration as fixed by the company. Registered office, 13, Elm Street, Gray's Inn Road, W.C.

Foote & Milne, Limited (73,923).—This company was registered on June 3rd, with a capital of £15,000 in £1 shares (5,000 preference), to carry on the business of electrical, mechanical, hydraulic and general engineers, contractors, brass founders, metal workers, tool makers, mechanists, metallurgists, &c., and to take over the business now carried on by H. Foote, L. Milne and E. J. Owen at 64, Victoria Street, S.W., as Foote & Milne. The first subscribers (each with one preference share) are:—L. Milne, 66, Victoria Street, S.W., electrical engineer; H. Foote, 66, Victoria Street, S.W., electrical engineer; E. J. Owen, 66, Victoria Street, S.W., electrical engineer; P. Dove, 44, Mostyn Road, North Brixton, electrical engineer; C. R. Gadsden, 49, Birchdale

Road, Forest Gate, accountant; R. Hern, 256, Wandsworth Bridge Road, Fulham, clerk; and P. F. Abbott, 76, Gaskarth Road, Balham Hill, S.W., storekeeper. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are H. Foote, L. Milne, and E. J. Owen, each of whom may retain office so long as he holds £2,500 shares. Remuneration of H. Foote and L. Milne, £364 each per annum; of E. J. Owen, £243 per annum.

Art Fittings, Limited (73,907).—This company was registered on June 2nd, with a capital of £10,000 in £1 shares, to carry on the business of manufacturers of, and dealers in, fittings for electric, gas, and oil light, and other illuminants, electric heating and cooking apparatus, storage batteries, lamps, lampholders, telephones, bells, bell pushes, speaking tubes, cables, wires, switches, wall attachments, meters, fuses, lightning arresters, testing apparatus, dynamos, motors, electrical novelties, electrical apparatus and machinery, art metal work, fenders, fire irons, door plates, screens, gates, railings, art glass shades, &c. The first subscribers (each with one share) are:—A. C. Read, 66, Victoria Street, S.W., secretary; R. Dand, 25, Westhorpe Street, Putney, secretary; F. Jarrett, 128, Lordship Road, Stoke Newington, accountant; T. B. C. Nuttall, 12, Princess Road, South Norwood, S.E., electrical engineer; A. Payne, 2, Marmion Road, Clapham Common, S.W., electrical engineer; C. S. J. Freeman, 67, Primrose Mansions, Battersea Park, S.W., electrical engineer; and H. E. Benwell, 29, St. Stephen's Avenue, Shepherd's Bush, W., electrical engineer. No initial public issue. Table "A" mainly applies. Probable dealings with Drake & Gorham, Limited, are mentioned in the articles. Registered office, 66, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

General Electric Tramways Company, Limited (43,428).—This company's annual return was filed on April 8th, when 18,000 shares were taken up out of a nominal capital of £50,000 in £1 shares £1 per share has been called up, resulting in the receipt of £18,500. Mortgages and charges: £15,000.

Hartlepool Electric Tramways Company, Limited (49,734).—This company's annual return was filed on April 8th, when 5,000 ordinary shares were taken up out of a nominal capital of £100,000 in 5,000 preference and 5,000 ordinary shares of £10 each. £10 per share has been called up, resulting in the receipt of £50,000. No mortgages or charges.

SUPPLY STATION ACCOUNTS.

South Shields Corporation Electricity Accounts.

THE accounts for last year of the Electricity Department of the South Shields Corporation represent the first period of the new management. The notable item in the general statement is a reduction in the gross amount expended upon maintaining the supply, which Mr. J. H. Cawthra, the borough electrical engineer, has been able to reduce by £13. The progress made in the last five years is as follows:—

	Units generated.	Units sold. Private.	Public lamps.	Maximum load.	No. of public lamps.	Gross profit.	Net profit.
1897	153,338	82,172	41,729	127 KW.	31	£144	—£1,676
1898	391,637	200,808	107,300	323 KW.	63	£2,149	— £882
1899	634,464	394,039	107,800	500 KW.	63	£4,231	— £73
1900	944,629	573,094	182,732	705 KW.	191	£6,276	+£1,024
1901	985,646	655,574	330,072	767 KW.	283	£7,751	+ £595

Of the increase in capital expenditure, the larger portion has been laid out on new mains. As the total plant installed is 1,900 KW., there is ample reserve for increase in load without further capital expenditure on the works.

GENERAL STATEMENT.

	1900.	1901.	Inc.
Total capital expenditure ...	£128,488	**£138,801**	£10,313
Number of units sold	755,826	**985,646**	229,820
No. of 8-C.P. lamps connected ...	35,025	**41,680**	6,655
Maximum load in KW.	705	**767**	62
Gross revenue	£12,191	**£13,653**	£1,462
Gross expenditure...	£5,915	**£5,902**	—£13
Gross profit	£6,276	**£7,751**	£1,475
Average price per unit sold ...	3·70d.	**3·24d.**	—·46d.

The lamps installed have increased by 19 per cent., the consumers by 14 per cent., the load by 8 per cent., and the units by 30 per cent. The rates charged are now 7d. and 2d. during the two winter quarters. The reduction in price has caused the receipts from energy sold to fall nearly ¼d. The average from private consumers taken alone is 3·9d. per unit, and for street lighting 1·3d. per unit.

REVENUE STATEMENT.

	1900. Gross.	Per unit.	1901. Gross.	Per unit.	Inc.
Sale of energy	£11,658	3·70d.	**£13,316**	3·24d.	—·46d.
Meter rents	280	·09d.	**337**	·08d.	—·01d.
Supply of lamps, &c	—	—	—	—	—
Sundry fees, rents received, and compensation.	253	·08d.	—	—	·03d.
Gross revenue ...	£12,191	3·87d.	**£13,653**	3·32d.	—·55d.

The cost of production has been greatly reduced, standing now at 1·44d. per unit for total costs inclusive of all charges, or 1·29d. if certain outside expenses be deducted. This Mr. Cawthra claims is absolutely the lowest cost of production recorded to-day by any electricity supply works generating for lighting only. Rather more than half of the saving has been made on coal, the rest being distributed over the various other items which, with the exception of repairs due to troubles on the mains, have all fallen.

COST OF PRODUCTION.

	1900. Gross.	Per unit.	1901. Gross.	Per unit.	Inc.
Coal..	£2,108	·67d.	£1,787	**·43d.**	—·24d.
Oil, waste, water, and engine room stores.	259	·08d.	184	**·05d.**	—·03d.
Salaries and wages incurred in generation and distribution, and attending street lamps.	1,518	·48d.	1,606	**·39d.**	—·09d.
Repairs and maintenance of buildings, boilers, engines, dynamos, and renewals of public lamps.	502	·16d.	821	**·20d.**	+·04d.
Works cost ...	£4,387	1·39d.	£4,398	**1·07d.**	—·32d.
Rent, rates and taxes ..	252	·08d.	193	**·05d.**	—·03d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	781	·25d.	857	**·21d.**	—·04d.
General establishment charges, stationery and printing, law charges and insurance.	495	·16d.	454	**·11d.**	—·05d.
Other expenses..	—	—	—	—	—
Total costs ...	£5,915	1·88d.	£5,902	**1·44d.**	—·44d.

The smaller net profit is explained by the further re-adjustment of the sinking funds, causing the financial charges to take a sum of £1,904 more than in 1900. As the gross profit was increased by only £1,475, the difference of £429 brought the net profit down to £595.

PROFIT STATEMENT.

	1900.	1901.
Interest on loans	£3,185	£4,018
Sinking fund for repayments	2,067	3,138
Net profit carried forward	1,024	595
Gross profit	£6,276	£7,751

CITY NOTES.

British Electric Traction Company.

THE following report is to be presented to the shareholders at the sixth ordinary general meeting of the company, to be held at Hamilton House, Victoria Embankment, E.C., on Monday, June 16th, at 12 o'clock noon:—

The directors beg to submit their report and statement of accounts for the year ended March 31st, 1902.

Profit and Loss Account.—The profits, including £21,457 5s. 7d. brought forward from last year, amount to £224,727 5s. 5d. This does not take into account the premiums, amounting to £121,184 11s. 6d. received in respect of new share and debenture capital, which have been carried direct to reserve. After deducting the proportion of general expenses chargeable to revenue, and also the expenses incurred in connection with schemes not proceeded with and written off, sundry reserves, contributions to superannuation fund and interest on debenture stock, there remains a net profit of £158,307 7s. 8d., which the directors propose should be applied as follows:—

Reduction of goodwill account	£1,500	0 0
Reduction of licenses and testing of new systems account ..	2,500	0 0
Reduction of furniture account	510	14 0
Dividend at the rate of 6 per cent. per annum on the preference shares for the year ended March 31st, 1902, including the dividend paid to February 15th, 1902, and proportion of dividend payable August 15th, 1902, accrued to date	51,847	4 9
Dividend at the rate of 12 per cent. per annum on the ordinary shares for the half-year ended March 31st, 1902, making with the interim dividend at the rate of 6 per cent. per annum paid for the half-year ended September 30th, 1901, a total distribution of 9 per cent. for the year	71,511	1 11
Carried forward to next account	27,488	7 0
	£158,307	7 8

The directors further propose that each shareholder should receive out of the issue of 20,000 ordinary shares referred to below, an allotment at par of one ordinary share in respect of every 10 shares, whether ordinary or preference, held on June 6th, 1902.

Capital Account.—The option given to Messrs. J. S. Morgan and Co. and the Electric and General Investment Company, Limited, to call for allotment of the unissued balance of 37,926 ordinary shares and 10,000 preference shares was exercised on July 8th, 1901, and the shares have been duly allotted and paid for in full. There has also been issued £210,906 5 per cent. perpetual debenture stock. The total premiums received in respect of these issues, after deducting the expenses, amount to £121,184 11s. 6d., and the whole of this amount has been added to reserve, which now stands at £459,705 4s. 10d. The subscribed share and debenture capital at March 31st was:—

£1,000,000 in ordinary shares of £10 each.
£1,000,000 in 6 per cent. cumulative preference shares of £10 each.
£810,906 in 5 per cent. perpetual debenture stock.

£2,810,906

The directors recommend that the nominal capital of the company be increased by the creation of 100,000 ordinary shares of £10 each and 100,000 preference shares of £10 each. A part of this new capital is required to carry out the absorption of the Electrical Power Distribution Company by an exchange of shares referred to below. It is proposed to make an immediate issue of 20,000 ordinary shares by allotment to the shareholders, as stated above. The directors consider it undesirable to make any public issue of ordinary shares at the present time, as, in their opinion, the market price of the shares is below what they consider to be their value.

Contracts and Undertakings.—The balance under this head, after deducting the cost of undertakings transferred, and after writing off expenses incurred in respect of schemes not proceeded with, but including a proportion of general expenses, is £199,179 2s. 5d., made up as follows:—

Expenditure on works and undertakings for account of other companies		£26,725 0 1
Expenditure on works and undertakings owned or leased by the B.E.T. Company, and for general stores	£103,588 5 6	
Less reserved	4,000 0 0	99,988 5 6
Expenditure in connection with schemes in course of development, and on Acts of Parliament, provisional orders, light railway orders, and other rights and powers secured or in course of promotion	£77,465 16 10	
Less reserved	5,000 0 0	72,465 16 10
		£199,179 2 5

Investments.—The total amount of investments, after deducting cost of securities sold, stands at £2,332,932 17s. 9d., and is made up as follows:—

Consols, cost		£161,757 19 8
Loans and advances to associated companies and others, and deposits		144,575 16 1
Mortgages, debentures, and debenture stock and shares of associated and other companies, cost	£2,036,299 2 0	
Less reserved	10,000 0 0	2,026,299 2 0
		£2,332,932 17 9

N.B.—There are certain contingent liabilities in respect of some of these investments. A portion of the Consols is deposited with the Paymaster-General in respect of Acts of Parliament, &c.

Electrical Power Distribution Company, Limited.—The company has a large holding in the Electrical Power Distribution Company, and the two companies have joint interests in several combined electric lighting, power, and traction undertakings. Your directors are of opinion that the efficiency of the combined organisations will be increased, and that economies can be effected by the complete absorption by the company of the Electrical Power Distribution Company. With this view the directors propose to offer to the other holders of shares in the E.P.D. Company one B.E.T. fully paid ordinary share for each fully paid ordinary share in the E.P.D. Company, and one B.E.T. fully paid preference share for each E.P.D. Company fully paid preference share. There are also 200 deferred shares of £1 each in the Electrical Power Distribution Company, which were issued and paid for in cash at the time of the formation of the company. They are held by Messrs. E. Garcke, J. S. Raworth, W. L. Madgen, R. Percy Sellon, and G. Offor. In 1900 an agreement was made between the E.P.D. Company and the holders of these shares, by which the E.P.D. Company has the option, exercisable at any time within ten years from January 1st, 1900, to extinguish the special rights attaching to such shares on the basis of the payment of £10,000 in cash. An agreement has now been made between the B.E.T. Company and the holders of the deferred shares, giving the B.E.T. Company the option within 12 months from June 6th, 1902, of purchasing the 200 deferred shares at the price of £10,000, payable in cash, or, at the option of the B.E.T. Company, in fully paid ordinary shares of the B.E.T. Company at the market price of the day on which the option is exercised, and upon the condition that the B.E.T. Company shall exercise such option in the event of its acquiring a majority of the ordinary and Preference shares of the E.P.D. Company within the period aforesaid. It is intended to offer Mr. Madgen, the managing director of the Electrical Power Distribution Company, a seat on the board.

British Electrical Superannuation Fund.—This fund is now in full and satisfactory operation. At the end of 1901 the membership was 81, and 29 associated companies and undertakings had signified their intention to contribute to the fund on behalf of their salaried staff. The sum of £452 2s. 3d. has been contributed by the company during the past year.

British Electrical Friendly Society.—Attention is called to the particulars of this society on page 21. The society was constituted in December last, since when 19 branches have been formed in various parts of the country, and 1,255 men in the service of the British Electric Traction Associated Companies have joined the society.

The directors who retire this year are Mr. C. Shirreff B. Hilton and the Hon. Sir Charles W. Fremantle, K.C.B., and both are eligible for re-election. Messrs. Fred. W. Smith & Co, the auditors, retire, and offer themselves for re-election.

Perth Electric Tramways Company.

The report, covering a period of 18 months to December 31st, 1901, states that seven miles have been in operation for three months, 10¼ miles for 3¾ months, and 13 miles for 11¼ months, being an average of about 11½ miles during the 18 months. The total gross revenue earned from this mileage during that period amounted to £60,268. During the 18 months covered by the accounts £102,109 has been spent on the construction of further sections, extra motive power and additional cars. Since the date of the accounts additional routes have been completed, making the total mileage now in operation 16½ miles. The accounts show a net profit from working of £21,697, from which has to be deducted interest on debenture stock and loans, leaving a net balance of £7,354. From this it is proposed to pay interest on the cumulative preference shares to June 30th last, which will leave a balance of £4,081. After allowing for the debit of £2,957 brought forward from last account, a credit balance of £1,124 is carried forward. The meeting was held in London yesterday.

Belliss & Morcom, Limited.

The report for the year ended March 31st states that the profit for the year, after making ample provision for depreciation, &c., and after payment of the preference dividend, amounts to £32,853. The directors have already distributed an interim dividend on the ordinary shares at the rate of 5 per cent. per annum; they now propose to pay a further dividend, making 12½ per cent. for the year, to place £10,000 to the general reserve fund, and to carry forward the balance, together with the amount brought forward from the preceding year. The directors have made a further issue of preference shares; these have been placed at a premium, which has been added to the reserve fund.

Prospectuses.

On Wednesday the list of subscriptions closed in an issue of £135,000 4 per cent. first mortgage debenture stock of Willans and Robinson for completing the Queen's Ferry and Rugby works, and for providing additional machinery, working capital, &c.

The Bromley (Kent) Electric Light and Power Company, Limited, has been inviting applications for an issue of 4,000 £5 ordinary shares (5s. premium) and £50,000 4½ per cent. first debenture stock. The list closed last Friday.

The list was opened on Tuesday, and is to close to-day in an issue of 18,000 ordinary shares of £10 each in the Blackpool & Garstang Light Railway Company, which has powers for laying about 14 miles of line, to be worked electrically on the overhead system. A portion of the line may be opened for traffic in the summer of 1903.

The Middleton Electric Traction Company, Limited, has announced an issue at par of £50,000 4 per cent. first mortgage debenture stock. Part of the expenditure has been met by the proceeds of the issue of 10,000 ordinary shares, and by advances from the B.E.T. Co., Limited, amounting on May 31st, 1902, with interest, to about £58,490. The present issue is made in order to repay these advances, and to meet the balance of the amounts due on the contracts for the construction and equipment of the lines and the completion of the car depôt.

The subscription list will close on Monday next of an issue of $7,500,000 5 per cent. Consolidated Mortgage 50-year Gold Bonds, in bonds to bearer of $1,000 each, in the Havana Electric Railway Company, an American company.

W. T. Henley's Telegraph Works Company.

The directors' report to be presented to the shareholders at the ordinary general meeting to be held at the Cannon Street Hotel on Friday, June 20th, 1902, at 12 o'clock noon, reads as follows:—

"The negotiations for the amalgamation of the company with Messrs. Callender's Cable and Construction Company, Limited, are still proceeding, and the directors are therefore unable to submit the terms to the shareholders, as intimated in their circular of February 21st last. The directors are of opinion, however, that the payment of the final dividend should not be longer deferred; they therefore now submit the annual report, and will communicate the terms of the amalgamation to the shareholders as soon as the negotiations are completed. The annexed accounts show that during the past year a net profit has been made of £64,447 19s. 9d. After payment of directors' and auditors' fees, debenture interest and income-tax, and making the usual allowance for depreciation of buildings, plant, machinery, &c., there remains £57,449 13s. 3d., making, with £24,210 16s. brought forward from last year, a total of £81,660 9s. 3d. The directors have transferred £1,000 to the debenture redemption sinking fund, and £11,000 to the reserve account, and they recommend the payment of a dividend on the ordinary shares at the rate of 20 per cent. per annum (less income-tax), including the interim dividends of 5 per cent. paid on September 1st, 1901, and 10 per cent. paid on March 1st last. These payments will, together with the preference dividend for the year, amount to £54,875, leaving £26,785 9s. 3d. to be carried forward. The dividend warrants will be posted on June 20th, 1902. Mr. Sydney Gedge and Mr. Frederick Newton retire by rotation in accordance with the provisions of the articles of association, and, being eligible, offer themselves for re-election. The auditors, Messrs. Ball, Baker, Deed, Cornish & Co., retire, and, being eligible, offer themselves for re-election."

Correction.—With reference to the remarks which appeared in our "Stocks and Shares" Letter last week regarding the B.I.W. and the Telegraph Manufacturing Co.'s issue, we learn that the whole of the debentures *were* subscribed; in fact, the issue was more than covered twice over, and the list closed a day earlier than was intended.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending June 6th were £1,029; corresponding week last year, £674: increase, £355. Total to date, £15,674; corresponding period last year, £13,577; increase, £2,097. Miles of track open, 11¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending June 7th were £476; corresponding week last year, £878; decrease, £402. Total receipts to date, £7,374; corresponding period last year, £7,871; decrease, £497.

Bristol Tramways and Carriage Company.—The receipts for the week ending June 6th were £4,678; corresponding period last year £4,406; increase, £272.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending May 30th:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	545	—	—	21½	8,550	—	—
Dudley–Stourbridge	715	—	522	21½	14,671	2,491	—
Gateshead¶	737	241	—	21½	14,130	977	—
Greenock-Pt. Glasgow	555	310	—	21½	9,0 2	5,140	—
Hartlepool	276	—	52	21½	4,731	365	—
Kidderminster ..	122	—	187	21½	2,269	41	—
Merthyr‡	213	—	168	21½	4,194	—	657
Middleton*	470	—	—	21½	2,956	—	—
Oldham—Ashton ..	634	23	—	21½	10,476	109	—
Poole†	259	—	151	21½	4,684	—	75
Potteries	1,4 9	—	301	21½	30,195	1,032	—
Southport	366	—	3	21½	4,166	1,213	—
South Staffordshire†	814	—	505	21½	16,158	409	—
Swansea	457	—	133	21½	9,110	759	—
Taunton*	62	—	—	21½	1,228	—	—
Tynemouth§	262	—	107	21½	4,549	251	—
Wolverhampton Dist.	147	44	—	21½	3,069	1,573	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only. ¶ Comparison from May 8th only. The corresponding week last year was Whitsun week.

Central London Railway.—The receipts for the week ending June 7th were £7,896; corresponding week last year, £6,064; increase, £1,274. Total receipts to date, £154,819; corresponding period last year, £142,535; increase, £12,284. Miles open, 6.

City and South London Railway.—The receipts for the week ending June 8th were £3,074; corresponding week last year, £1,929; increase, £1,145. Total receipts to date (23 weeks), £68,496; corresponding period last year, £45,363; increase, £23,133. Miles open, 6½; last year, 4½.

Dover Corporation Tramways.—The receipts for the week ending June 7th were £259 0s. 10d.; corresponding week last year, £220 5s. 6d.; increase, £38 15s. 4d. Total to date, £4,825 12s. 10d.; corresponding period last year, £4,170 15s. 6d.; increase, £154 17s. 6½d. Miles of track open, 3. Car miles run, 1902, 5,287; 1901, 5,114. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending June 6th were as follows:—D.U.T. Co., £3,619 11s. 11d.; D.S.D. Co. £814 15s. 1d.; total, £4,454 7s.; corresponding week last year—D.U.T. Co., £3,819 13s. 7d.; D.S.D. Co., £927 9s. 6d.; total, £4,747 8s. 1d.; decrease, £292 16s. 1d.; aggregate to date, £96,418 5s. 10d.; last year, £92,608 16s.; increase, £3,814 9s 10d. Mileage worked, 46.

East Ham Tramways.—The receipts for week ending June 7th were £450 14s. 4½d.; total to date, £18,464 Cs. 8d. Car miles run, 10,602; number of cars, 25.

Glasgow Corporation Tramways.—Week ending June 7th, £12,182 7s. 7d.; last year, £11,598 1s. 3d.; increase, £584 6s. Miles of track open, 52½; last year, 48½. Car miles run, 248,760; last year, 212,708. Approximate number of cars, 480; last year, 380.

Liverpool Overhead Railway.—The receipts for the week ending June 8th were £1,506; corresponding week last year, £1,651; decrease, £145. Total to date £32,874; corresponding period last year, £36,106; decrease, £3,232. Miles open, 6 miles 57 chains.

Sunderland Corporation Tramways.—Week ending June 8th, £1,140; corresponding period last year, £1,150. Total receipts to date, £10,758; corresponding period last year, £9,916; increase, £842. Miles open, 17 89.

STOCKS AND SHARES.

Wednesday Evening.

ONCE more the Stock Exchange is suffering from an overdose of speculative activity. A number of wild plunges in the Kaffir market, whose hopes were damped by the fall which ensued upon the Peace news, and who were not sufficiently strong to continue their commitments, have been obliged to close their shares, and the forced selling was felt through all the other markets of the House. Luckily, however, the strength of Consols furnishes a strong support to sections like the electrical, which depend so much upon the investment feeling that is abroad. Since it was announced that the purchase of Goschens for account of the sinking fund is to be resumed, the premier security has boldly shaken off its earlier weakness, and it is mainly due to this fact that our lists show so few declines, while two or three items stand out favourably with an advance on the week's work.

In the Home Railway section, the electrical stocks are the firmest in an otherwise listless market. Waterloo and City is a point to the good upon the expectations of the line doing well over the Naval Review traffics. Moreover, the appetite which is awakening in the public taste for 3 per cent. stocks is another reason for the better quotation. It is reasonably advanced that if people will readily subscribe 3 per cent. Colonial and Corporation securities at prices between 95 and 97, they will probably turn their attention later on to this thoroughly well-secured stock. The position of late having completely changed in regard to investment securities, it is not improbable that Waterloo and City stock may go to 99 or thereabouts. Central London Ordinary is also a little better, the line's traffic receipts telling in its favour. The company's Coronation preparations at Shepherd's Bush are quite elaborate, and the station will form a pretty sight at illumination time. Metropolitan Consolidated stock is 83, and District Ordinary keeps about 32½.

British Electric Tractions are a good market, although no variation has to be recorded in the quotations. The report, which is detailed in another column, is considered excellent, and it should assist the price in the rise of a sovereign, which it seems fair to prophesy for the Ordinary shares. They can now be bought at 14 or a fraction over. Anglo-Argentine Trams are better at 4⅜, and Buenos Ayres and Belgrano "B" Preference have been wanted at 5½. Brisbane Electric Preference at 4¾ are a little better, but there is no change in Perth Electric Tramways Debenture stock on the issue of the report. At 101½ the security appears to be cheap, since the company was earning its debenture interest nearly twice over in the period covered by the report, and the document speaks of steady progress since the accounts were made up to December 31st last.

New issues of "Traction" descriptions are making their appearance rapidly. The Havana Electric Railway Company now before the public is the outcome of the private concern operating in Cuba, of which we have from time to time given particulars in this column. Five per cent. consolidated mortgage 50-year gold bonds are now offered to the extent of 7¾ million dollars at the fixed price of 98, which give a return of about 5½ per cent. to the subscriber. The Havana Electric is not an English company; it is registered under the lax laws of the State of New Jersey, but the names of the directors carry great weight on both sides of the Atlantic. So important an issue is receiving much more attention than that of the light railway in Surrey advertised a few days ago, which had little to commend it except as a speculation.

Electric lighting shares are steady, and the list shows one solitary fall as the only fluctuation since we last wrote. Brompton and Kensington Ordinary have receded to the same price as that quoted for the Preference. Speculation in Metropolitans is ceasing, the time for publication of the arbitrator's award being so near as to keep fresh operators out of the market. New Charing Cross Ordinary shares are 8½ and new Westminsters 3¾. Charing Cross "City Undertaking" Preference are changing hands at a small discount. The foreign and provincial issues are just as quiet as those of the London shares. Oxfords are 5½, Folkestones 6, Hove 7½, Bournemouth and Poole Ordinary 11½, Preference 10, and the Debenture stock 105½. Calcutta Electric Supply shares of both issues are £9 middle, Electric Lighting and Traction of Australia Preference 4½, and the 5 per Cent. Debenture Stock 102½. River Plate Electric Light and Traction Debenture is 72½: the last payment of interest was made in January, 1899. Royal Electric of Montreal Debenture is good at 104.

Telegraph stocks are quiet, the principal movements being a rise of 5 in Commercial Cable, and declines of 1 and ½ Anglo-American Preferred stock, and Eastern Extension shares respectively. The latter movement is due to the liquidation of several deceased accounts, one of which contained £00 shares. Telegraphic communication with the Philippines, interrupted by a break in the Hong Kong—Manila cable has now been restored. The Debenture stocks of both the Eastern companies are rather better. Henley's shares have not yet recovered their last week's decline, although the dividend is up to market expectations. Some disappointment is expressed at the length of time which the negotiations with the Callender's Company are taking. Callender's Preference are ¼ harder.

General Electric Preference keep at 10¼, unchanged by the fire and the pathetic loss of life which it caused. Electric Construction Debenture stock has hardened a point. British Insulated Wire shares are moving erratically, but Telephone issues have strengthened here and there. National Third Preference, however, are down ⅛ to 5, while United River Plate Ordinary at the same price have added ¼ to their quotation. It is not thought that there will be much revival of general activity in this market until after the Coronation festivities.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation June 4th.	Closing Quotations June 11th.	Business done during week ended June 11th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	44 — 47	44 — 47	46	45
3,097,640	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	88 — 90	87 — 89	88½	88¼
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.%	2s.	6¾— 7¼	6¾— 7¼	7⅛	6¾
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	3⅞	3 13/16
13,333,300$	Commercial Cable	$100	8 %	...	...	160 —170	165 —175	...	...
1,741,929£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	94 — 96	95 — 97	97	95⅝
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	12½— 13½	13	12½
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3½	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9½— 10½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	99 —102	99 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	...	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 — 102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	120 —130	120 —130	126	123
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	86 — 88	87 — 90	87½	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	107 —112	107 —111	...	...
360,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12½— 13½	12 — 13	13	12⅝
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	107 —112	108 —113	108½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub) 1—8,000	25	...	...	...	99 —102 %	99 —102%	101⅝	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	8 — 9	8 — 9	8⅞	8½
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	13⅛	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	25 — 27	25 — 27	25⅛	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41	37 — 41	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	100 — 104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	2½%	...	...	½— ⅝	½— ⅝	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	97⅜	...
200,000	Do Pref. shares	2	...	3⅛	3⅜	3½— 3⅝	3½— 3⅝	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	53 — 57	53 — 57	54¼	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	4⅞— 5⅛	5 1/16	5
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	94 — 97	94 — 97	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	103 —107	103 —107	106	105
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1 1/16— 1 1/16xd	1 1/16— 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4½— 5	4⅝— 5¼	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— b	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
155,600	West African Telegraph, 5 % Debs.	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Brss. Sub. Tel.	100	...	...	...	99 —102	99 —102	101⅜	101
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11½— 12½	12½	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	99 —102	99 —102	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	½— ⅝	½— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	3½— 4½	3½— 4½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	...	...	...	101 —104	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	...	...	...	½— ⅝	½— ⅝	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	8¾— 9¼	...	...
20,000	Do. do. 7 % Cum. Pref.	5	...	...	...	8¾— 9¼	8¾— 9¼	9⅛	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9⅜	9¼
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5⅜	...
250,000	Do. do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	106¼	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5 1/16— 5⅛	5 — 5⅛	...	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	110 —113	110 —113	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	4 %	0 %	5 %	8 — 9	8 — 9	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	7½— 8½	7½— 8½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	108 —111	108 —111	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6½— 6⅝	6½— 6⅝	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	108 —111	108 —111	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 4½	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	96¼	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	16½— 17½	16½— 17½	16 1/16	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	100½	98⅝
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15 3/16	15⅛
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	9 1/16	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅝— 2⅛	1⅝— 2⅛	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 3½	3 — 3½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½ %	10½%	11 — 12	11 — 12	11⅝	11½

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year, consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation June 4th.	Closing Quotation June 11th.	Business done week ended June 11th, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	..	...	...	4½ — 5½	4½ — 5½	...	...
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	..	86 — 90	86 — 90	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	13½ — 14½	13½ — 14½	14¼	13⅜
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12⅜	11 9/16
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	126	...
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	8½ — 9½	7½ — 8½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 5⅝	5½ — 6	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½ %	5 %	Nil	1½ — 1⅝	⅝ — 1½	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1⅝ — 2¼	1⅝ — 2¼	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	95 —100	95 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17 — 18	17 — 18	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5⅝ — 6¼	6 1/16	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	104 —106	104 —107	106½	105
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	106¼	104
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 —103	100 —103	101	...
855,000	City and South London Railway	Stock	1⅞ %	1¼ %	2 %	71 — 74	71 — 74	72½	71½
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	3 — 3½	3 5/16	3 1/16
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	103 —108 %	103 —108 %	105	104¼
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	2 — 3	1½ — 2½	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	75 — 80	75 — 80	75	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 87	82 — 87	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1½ — 1⅝	1½ — 1⅝	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	99 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	10 — 10½	10 — 10½	10⅜	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 —101	98 — 101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16½ — 17½	16½ — 17½	17	...
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½ — 6	5½ — 6	...	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅛ %	3¼ %	1¼ %	4 3/16 — 4 5/16	4 3/16 — 4 5/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10½ — 11	10½ — 11	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ — 16½	15½ —16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref. ...	£1	...	6 %	...	... — ...	19/0 to 20/0	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	20 %	34 — 37	34 — 37	36⅜	35½
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	103 —106	103 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	9½ — 10½	9½ — 10½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	92 — 95	93 — 96	94½	93½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, June 11th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	82/-	82/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£88 10	£88 10	..
a „ „ ..	per ton	£90	£90	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£18	£18	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	5d.	5d.	..
a „ Caustic (76/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	110/-	110/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (76 %)	per ton	£12 15	£12 15	..
a „ Crystals	per ton	£8	£8	..
a „ Bichromate, casks ..	per lb	2¼d.	2¼d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal Ingots.. ..	per ton	£40 to £110	£40 to £110	..
c Brass (rolled metal 9" to 12") basis	per lb.	6⅞d.	6⅞d.	..
c Tube (brazed)	per lb.	8¼d.	8¼d.	¼d. inc.
c „ „ (solid drawn) ..	per lb.	7d.	7d.	..
c „ Wire, basis	per lb	7d.	7d.	..
c Copper Tubes (brazed) ..	per lb	8⅞d.	8⅞d.	..
c „ „ (solid drawn) ..	per lb	9d.	9d.	..
g Copper Bars (best selected) ..	per ton	£69	£69	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£69	£69	..
g „ Rod	per ton	£69	£69	..
c „ (Electrolytic) Bars ..	per ton	£68	£68	..
c „ „ Sheets ..	per ton	£75	£75	..
c „ „ Rod ..	per ton	£68	£68	..
c „ „ H.C. Wire	per lb.	8d.	8d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/5	..
h Gutta-percha fine	per lb.	6/-	6/-	..
h India-rubber, Para fine	per lb.	2/11½ to 3/0½	2/11½ to 3/0½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	49/9	49/8½	½d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 10	£11 10 to £11 13 6	dec.
g „ „ Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/3	11½d. to 1/3	..
p „ rolled bars & rods	per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£132 to £133	£134 10 to £135 10	£2 10 dec.
g „ foil	per lb.	1/6	1/8	..
n „ wire, Nos. 1 to 18	per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£36 to £61	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb	7d.	7d.	..
j „ 8 ply Flax	per lb.	5⅞d.	5⅞d.	..
j „ 3 ply 10 lbs. Russian ..	per lb	5⅛d.	4½d.	..
j „ 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j „ 180 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vieille Montagne mod.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME NOTES ON POLYPHASE MACHINERY.

By A. C. EBORALL.

(*Paper read at Manchester, March 25th*, 1902.)

(*Continued from page* 959.)

ASYNCHRONOUS MOTORS.

The great advantages of the asynchronous motor (induction motor) over the synchronous machine are that its starting is simple, effective, and economical, that no direct current excitation is required, and that its speed can be regulated; on the other hand, it is inferior, because of its relatively large no-load current and its lower power factor, especially below three-quarter load. These features of working are well known and appreciated nowadays, and need not be discussed here; on the other hand, time does not admit of a discussion of the many interesting points connected with the actual design of these motors. But before concluding the paper, two points in connection with the subject may be referred to.

The first point relates to the starting capabilities of the induction motors used for every-day industrial purposes, as distinct from traction and similar work; regarding this question there still seems to be a certain amount of misunderstanding prevalent among those engineers who have been used more particularly to direct-current work.

The polyphase induction motor, constructed with a permanently short-circuited rotor winding, that is, with a squirrel cage rotor, or a modification of it, is naturally an ideal motor from the user's point of view. On account of its simplicity it is low in first cost, and easy to operate, and the cost of upkeep is negligible, insomuch as there is nothing to get out of order, or to require attention or renewal. But principally on account of the starting of motors of this type, it becomes necessary to limit the size of such motors when a large scheme for the distribution of power is concerned; the power station superintendent has, in fact, to insist that all induction motors connected to the mains shall be provided with rotor resistances for starting, when these motors exceed a certain size, say, about 5 B.H.P.

Induction motors, with permanently short-circuited rotors, require an altogether abnormal starting current, especially if they are required to start against any considerable load. For on account of the relatively low resistance of the rotor bars and connecting rings (or strips), there is nothing to limit the current taken at the moment of starting, except the magnetic leakage from pole to pole of the stator, and the lowering of the pressure on the motor terminals; the former will increase so enormously, that the useful rotor flux (that flux actually getting into the rotor and cutting the bars) will be relatively small. Thus the starting torque (which is proportional to the useful flux and to the rotor current) will be quite small, although the starting current of the motor is so great; moreover, this large starting current is (on account of the great leakage) of very low power factor, and thus causes very harmful effects on the pressure regulation of the system. Naturally, the pressure on the terminals of the motor also falls, which, in turn, affects the starting torque, as the latter is proportional to the square of the terminal pressure. For these reasons, the very best induction motors of this type on the market, when starting against the load offered by a belt and loose pulley only, take a current equal to at least twice the full load current; when starting with full load torque this will increase to three to four times the full load current. In the former case the rush of current is only momentary, but in the latter case the large current is required for some time, as the starting is certainly not good (unless the motor is provided with a special high resistance rotor, which means low efficiency at load), and hence it follows that, under the latter conditions of operation, the motor is liable to burn out—it will do so if there are any weak points in it, or if it takes too long to speed up.

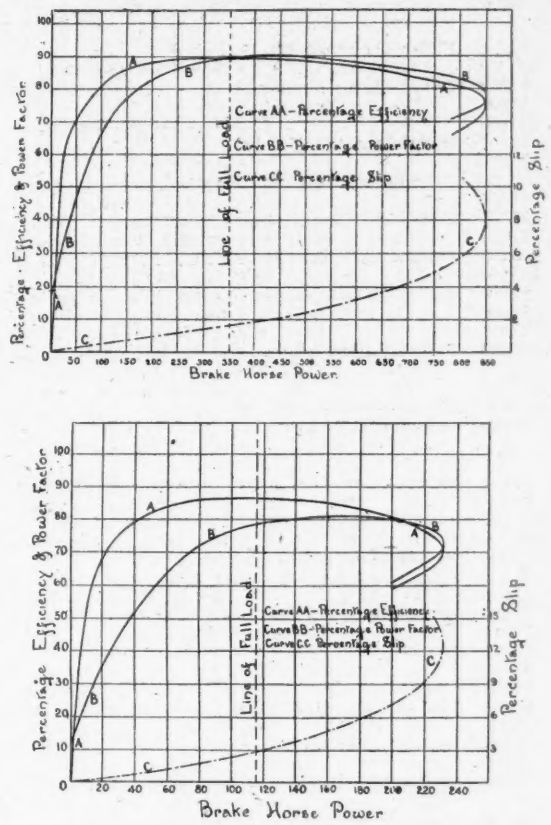
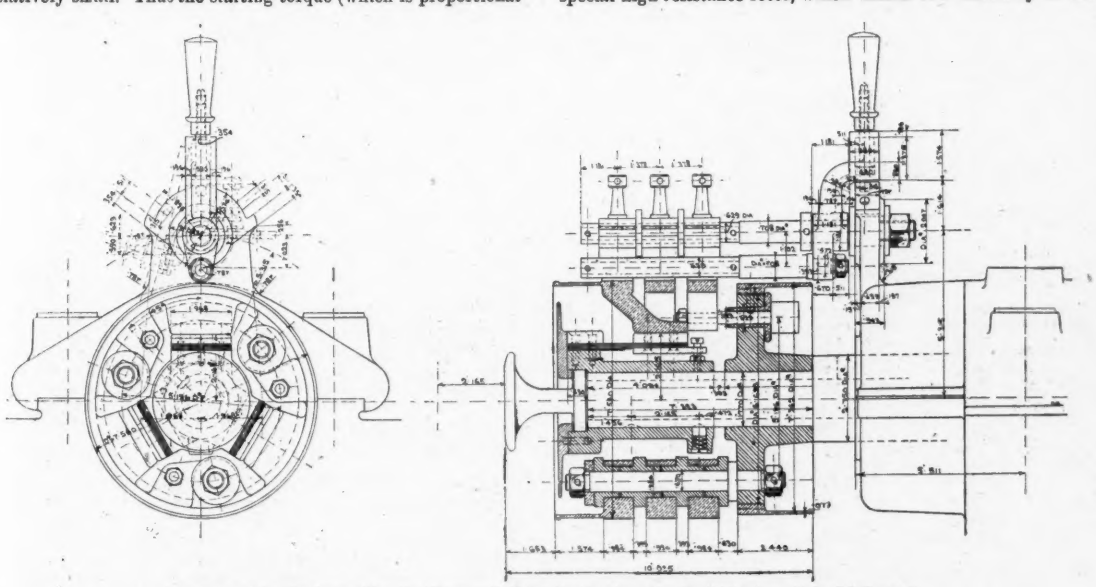


FIG. 18 (A and B).—TEST CURVES OF INDUCTION MOTORS.



Arrangement for short-circuiting the Rings and raising the Brushes after the Motor has attained full speed.

FIG. 19.—SLIP RINGS AND BRUSH GEAR FOR 60-B.H.P. INDUCTION MOTOR.

It will therefore be readily understood, from what has been said above, that the successful operation of a large power distribution scheme would be impossible if large motors of this type were used indiscriminately; even if there was no lighting work, the effect of the starting of such motors would be detrimental to the proper performance of other motors connected to the system. For this reason, it is absolutely necessary that all induction motors of any size should be fitted with slip rings, and be operated (at starting) with rotor resistances. In the author's opinion all motors above 5 B.H.P.,

having to start against load, should be so fitted; if they are not required to start against load, permanently short-circuited rotors can be used for motors up to 8 B.H.P. inclusive.

The introduction of a non-inductive resistance into the rotor circuits at starting, which can be gradually cut out as the motor speeds up, enables polyphase induction motors to start nearly as effectively and economically as the corresponding direct-current shunt-wound motors; as a matter of fact, the conditions are quite analogous in the two cases. The table given below is typical of the starting performance of modern three-phase motors (with slip rings) of absolutely standard design, that is to say, motors which have not been specially designed for large starting torques. The figures in question have been taken at random from a collection of test-room data relative to different sizes and makes of induction motor.

Normal rating of motor.	350 B.H.P.	30 B.H.P.	15 B.H.P.
No load speed	375	1,000	1,000
Frequency	25	50	50
Terminal pressure	1,000	500	500
Full-load current per phase	175	32	15
„ efficiency	94 %	90 %	88·5 %
„ power factor	91 %	90 %	90 %
„ slip	2 %	2 %	2·5 %
Maximum load before falling out of step (B.H.P.)	750	62	34
No load current	40	9	4
Torque at full load...	5,050	162	81
Starting torque with full load current ...	4,900	158	78
Maximum value of starting torque ...	11,500	350	206
Starting current for this value of torque	575	105	55

Note (*a*). The values above have been taken directly from the test-curves—all the tests were carried out at constant (normal) terminal pressure.

(*b*) All the values for the torque are expressed in pound-feet.

From the above table it will be seen that for a starting current equal to the full load current the torque at starting is about 97 per cent. of the full load running torque; moreover, the maximum starting torque is equal to 2·27, 2·15 and 2·55 times the full load running torque respectively. Such values as these are sufficient for all usual purposes, but clearly they can be largely increased if desired by altering slightly the design of the motor, taking, for instance, fewer stator conductors and a greater flux; the latter will, of course, cause corresponding increases in the no load currents of the motors, which are not, as a rule, objectionable.

The table also gives a good idea of the running performance of three-phase induction motors of standard design with respect to efficiency, power factor, slip, no load current, &c. For similar figures relative to slow-speed motors, a reference to fig. 18 (A and B) may be made.

When induction motors are fitted with slip rings and brushes in connection with the rotor windings, it always pays to make suitable arrangements for short-circuiting the rings and lifting off the brushes as soon as the motor has reached its full speed; in this way practically all wear of the brushes and rings is prevented, while the friction and copper losses that would otherwise occur at the brush contacts and the copper loss in the conductors leading to the starting box are done away with. As the rotor currents are in general very heavy, these losses are well worth taking care of. An arrangement of this character is shown in fig. 19; it is a very simple and effective device, not at all likely to get out of order, and is comparatively inexpensive; the size illustrated is suitable for an induction motor of 50—60 B.H.P. Motors provided with such arrangements approximate to the condition of motors with permanently short-circuited rotors when running, while when starting they are free from the disadvantages of the latter type.

The other point connected with polyphase induction motors which may be profitably referred to here is the great advantage of low frequencies for slow-speed motors. This is best illustrated by means of an example taken from practice. The curves in fig. 18 (A and B) refer to two slow-speed motors of respectively 350 B.H.P. and 115 B.H.P.; the former (fig. 18A) is a motor directly coupled to a mining ventilator running at 310 revolutions per minute, while the latter (fig. 18B) is directly coupled to a (Riedler) high-speed pump running at 200 revolutions per minute.

(To be concluded.)

AUTOMATIC RELAY TRANSLATION FOR LONG SUBMARINE CABLES.

By S. G. Brown.

(Paper read in London, May 1st, 1902.)

(Continued from page 960.)

Lord Rayleigh in testing magnetometrically a bar of iron, one end of the iron being very near the magnetometer, and with a compensating coil adjusted to balance the magnetism, which a feeble magnetising current induced in the bar, found that the compensation remained perfect if the magnetic force fell below 0·00004 C.G.S. Within this range of force there is no retentiveness. The magnetising process begins like the straining of a solid body with an elastic stage, within which there is no permanent set. Some electricians have thought that there must be a drawback to the use of iron in these shunts, especially as the iron forms a closed circuit. They have suggested air as being a more perfect material, but I think the above well meets their objection. The permeability of the iron of these inductive shunts when used for cable work is probably somewhere about 150 as against the 1,200, or thereabouts, when used as transformers for alternating-current lighting work, the permeability of air being 1.

Magnetic shunts have been designed, so that the molecules of iron may be shaken up by an alternating-current excitation. This alternating-current circuit is disposed so that there shall be no interaction between it and the shunt-winding. The permeability of the iron may thus be greatly increased. The method has been tried with satisfactory results. These magnetic shunts are of very great value in cable work, for they steady and curb the action of the relay coil, and without them relay working would be well nigh impossible. Their action on a siphon recorder is no less marked; using a "plain" automatic or hand-key as sender, they produce curbed signals, and this with an increase of speed.

The drum cable relay apparatus, so far as I have described it, is all that is necessary for simple translation on short cables, a hand-key being used at the first station, the relays, R′ R″, being connected to work two sounders, which sounders are joined up with a battery, in the same way as a hand-key, to transmit the messages over the second line; but in what follows I shall assume that at the originating station an "automatic transmitter" is employed.

Although scarcely necessary, it may be well here to call attention to the fact that when a cable is worked at its highest practical speed, many of the originating impulses are obliterated from the received signals whenever successive impulses of the same polarity or sign occur. It is, therefore, evident that if the impulses sent by the relay apparatus into the second cable are to be identical in character with those sent into the first, it is necessary to reproduce the missing "beats." The instrument used for this purpose is called an "interpolator." Its action resembles that of the automatic transmitter at the originating station, with this difference, that the movements of its transmitting levers, instead of being

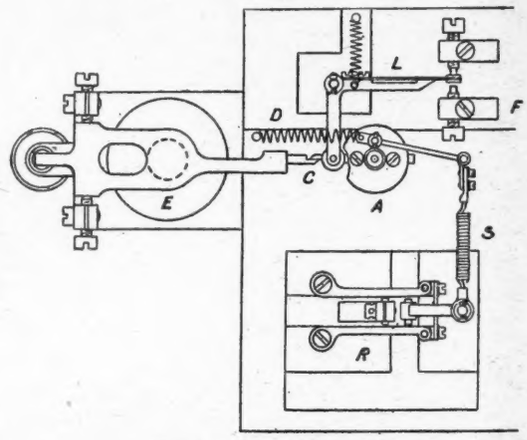


Fig. 2.—(See also Plate 2.)

governed by the perforations in the punched tape or strip, are governed by the motions of the relay tongue. The interpolator sends into the second cable impulses similar to those entering the first cable, and these may be either "curbed" or "plain," as required. To use this instrument to the best advantage, it is necessary that it should run in approximate synchronism with the automatic transmitter, and that the speed of the last-named instrument should be nearly uniform.

The interpolator consists of two sets of signalling levers, similar to each other, but mechanically distinct. One set sends on the "dot" signals and the other the "dashes." Fig. 2 shows the mechanism of one-half of the interpolator, which acts as an automatic transmitter, forwarding the "dot" signals received by the drum relay from the first into the second cable. The electro-magnet E is worked from the relay R′ of fig. 1. The other set of mechanism, or "dash" side, not shown, is worked from the relay, R″. When the electro-magnet E is energised, it pulls down its armature, removing the catch, C, from holding the clutch-sleeve, A, and allowing it to revolve. The clutch-sleeve, as it revolves, moves the lever, L, so as to make contact with the lower contact point, F, this putting battery to line; S is a spring lever worked from a crank-pin on top of the clutch-sleeve; the crank-pin revolving, rocks the lever, and operates the reverser, R, to which the battery is connected, and this, at stated times in the revolution, reverses the battery, which acts as a curb to the first battery current, or cutting off the battery and putting the line to earth, to act as "plain" automatic, as the case may be. By moving the reverser, R, relatively to the crank-pin, a bias may be given to the spring of the lever, S. Such a motion will allow of the duration of the curb or earthing period being adjusted. D is a spiral spring to help the clutch-sleeve to ride over its lifting rollers. The clutch mechanism is driven by a small governed electro-motor. The clutch is more particularly shown in fig. 3. S is a rotating spindle

to which the collar, G, is fixed. The clutch-sleeve, loose on the spindle, carries on its end the cam plate A, and is provided at its lower end with teeth, which are adjusted to gear with similar teeth on the collar. A spring, B, tends to force the clutch sleeve into engagement with the collar. The sleeve is provided with pins or projections, one of which, C, engages with the arresting device, and these ride upon fixed lifting rollers L L (which are shown dotted) when the sleeve is at rest, and thereby raise it out of engagement with the rotary spindle. When the arresting device is removed by the magnet, E, the clutch sleeve is pulled off the rollers, L L, by a spring pulling at the crank-pin, D, and thus thrown into gear with the spindle, operating the transmitting levers as previously described.

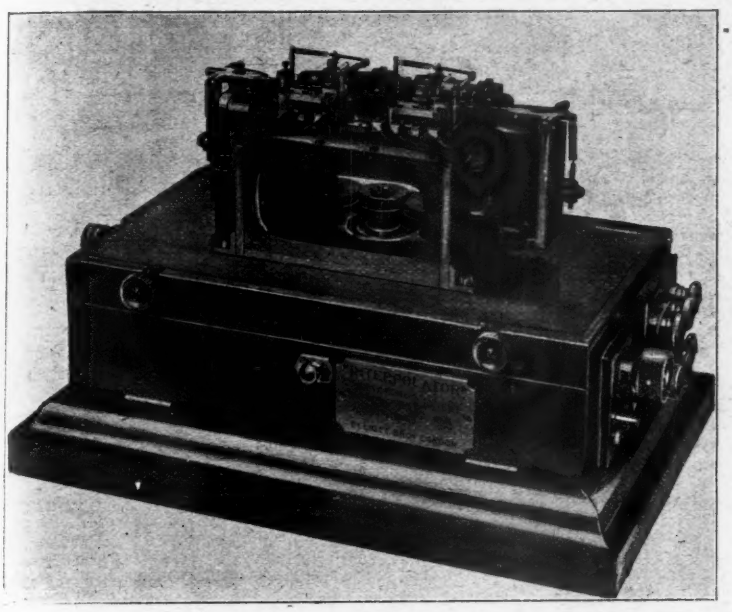


Plate 2.—Interpolator.

Fig. 3.

When an *h* is received from a long cable on the drum of the relay, the tongue remains in contact with the dot side throughout the four beats of the letter, simply producing one long contact on the "dot" Post Office relay. This long signal is split up by the interpolator and transmitted as four dots.

(To be continued.)

THE AMERICAN INVASION.

A good deal is made in the *New Liberal Review* of the American invasion so called. What does it all amount to? For several years past there have been good harvests in America. The consequence of this good time for what constitutes four-fifths of the industry of the United States is that American railroads, the steel works that sell to these lines and all who prey on the poor Western farmer have been making money. We, on the other hand, have spent a lot of money in South Africa, partly, we might say, to fit it for the sale of German and American goods at preferential rates over our own goods. Is it surprising that over wealthy Americans finding in England an opportunity of profit should come over to reap that profit? Our own capitalists have declined to consider electrical undertakings as worth their money. Naturally for loss or profit other capital has obtained control. It may be that the Americans will drop money in some of their tube undertakings. If Americans would act fairly, there could be no reason to object to their using their capital here. But there is a suspicion that American financial methods are crooked. They have appeared very curious in the tobacco trust business.

People doubt their *bona fides* in the shipping business, which is one of the tentacles of the Steel Trust. The American people themselves, the multi-millions who are not multi-millionaires, have less love for trusts than we as yet have in Great Britain, whether it be in beef or steel, and the poor dried-up weazened Western farmer, the only unprotected crittur in "God's own country," hates them worst of all. This country has for long been a Free Trade country and has prospered by its policy, but has, strangely enough, secured nothing but foreign hatred by its freedom. We are not much in accord with Mr. Theo. Feilden, but it must be said that he has a good deal of right on his side when he points out how unfairly the municipal officials deal with English manufacturers, who are tied down by all manner of restrictions from which the foreigner is free. The County and Borough Councils who have contracts for electrical machinery to give out, insist on the above-named restrictions as regards English-made machinery, but allow the German, the Belgian, and the American to dump their goods here at prices that are less than British prices, simply because there are no restrictions placed on the foreign workshop. As regards American products, of which Mr. Feilden speaks, it is, we believe, a fact that some municipal engineers specially exclude English products by well-known arts of specifying.

In the same review Mr. Arthur Donald expresses somewhat our own ideas that there is no occasion to weep because capital is attracted here.

Have we not heard *ad nauseum* that for years capital has sought its investments too much abroad? Now that capital actually comes here, we are asked to be afraid.

It is true that the general tone and attitude of the American is too much tinged with insolent contempt of all things British, but it would be difficult for him to come up to the level of hatred we all feel for certain railways. The fact that we have done so well in England with such a class of man to block progress as is found on so many railway boards, is proof enough of vitality somewhere, and it is creditable to Mr. Yerkes that he has been able to move and effect something in the railway atmosphere.

It is said that certain undertakings in this country are merely the tentacles of the Steel Trust, and have resolved to crush out all competing industries. This is an American attitude that cannot be looked on with approval, and should it be persisted in, it might happen that the people of this country would resolve to change their long fixed policy and put a sharp stop on such practices. There is a large number of people already desirous of protection. They are chiefly the young, who do not remember the old days of protection, and are unconscious that their arguments as to the ruin of the country are but repetitions of what may be found in any file of 60 years old newspapers.

It would be a pity to depart from our free trade policy, but if a majority of the people decided to do so, under the belief that foreign methods of finance were unfairly influencing the prosperity of the country, protection would be inevitable, and would probably defeat its own intentions. A termination of the war and a resumption of the usual course of commercial activity, together with a little more "wake up" of our rich men, should do a good deal to keep American enterprise within fair and legitimate lines. We can certainly see no wrong in the fact of using foreign capital to help British progress. It may be a return for the many hundreds of millions sterling paid by Great Britain to build up American railroads, much of which capital was lost for ever by rotten finance.

New Edition.—A fifth edition of Mr. Perren Maycock's well-known "Electric Lighting and Power Distribution," Vol. i., has just been issued by Messrs. Whittaker & Co., of Paternoster Square. The book has been subjected to revision and correction throughout, the last chapter having been practically re-written. Therein will be found descriptions and illustrations of several up-to-date types of direct-current generator.

GERMAN STORAGE BATTERY COMPANIES.

DISSOLUTION OF THE ACCUMULATOR SYNDICATE.

THE syndicate of makers of storage batteries in Germany has now been dissolved. It was formed about a year and a half ago, when the cost of raw materials was high, for the purpose of advancing the prices of accumulators commensurately with the greater outlay incurred in manufacturing operations, and its sphere of activity was restricted wholly to stationary batteries or those used for lighting and power stations. Since then, however, raw materials have declined below the level attained prior to the constitution of the syndicate, and as the latter declined to entertain a proposal made by the Berlin Accumulator Company to reduce prices to a proportionate extent, the company withdrew from the organisation in April, and at the same time lowered its quotations by 20 per cent. as compared with the list charges of May, 1900. The immediate effect of this action has been the retirement of other firms from the syndicate, and the collapse of the ring. A further reduction in prices amounting to 18 per cent. has been made by the company in question, but this is merely nominal, inasmuch as the rebates or discounts allowed have been curtailed to the same degree. It is not at all surprising to find the syndicate being dissolved in view of one firm after another withdrawing from it, but it is somewhat remarkable to hear of philanthropy in business matters which constrains one of the principal companies to take a step for giving its consumers the benefit of a diminution in the cost of raw materials. The action in this respect seems to suggest that the prices fixed by the syndicate were more or less nominal and incapable of being obtained. However that may be, another attempt is now being made to form a new syndicate of battery makers, or to establish a common basis of prices, but nothing definite has so far been settled.

The Accumulator Company, of Berlin and Hagen, which is interested in the Tudor battery, has a share capital amounting to £312,500, and has paid dividends of 10 per cent. since 1895 down to the end of 1900. As it has now been decided to make the financial period correspond with the calendar year, the report presented by the directors at the recent meeting only covered a period of six months, which terminated at the end of December, 1901. During the half-year the gross profits earned reached £71,856 as compared with £148,871 in the preceding complete financial year, and the net profits amounted to £24,019 as against £51,810. This sum allows of the payment of a dividend at the rate of 5 per cent. for the six months. The company, which owns factories in Hagen, Hirschwang and Buda-Pesth, has acquired the whole of the share capital of the Oberspree Accumulator Company, thus allowing it to again enter into friendly relations with the Berlin Company for Electrical Enterprises—the former proprietor of the Oberspree Works—and its associate, the Union Electricity Company, of the same city. When the report of the directors was written at the end of March, the value of the orders on hand at that time was £100,000 less than at the corresponding period of 1901, and as no improvement has taken place since then the turnover is less than was the case a year ago. Herr Correns, however, informed the shareholders at the recent meeting that there is no occasion for entertaining apprehensions in regard to the future.

The affairs of the Pollak Accumulator Company, of Frankfort-on-the-Maine, which was constituted in 1894, with the modest capital of £25,000, and subsequently increased to £100,000, have been revealed in a light that is exceedingly unsatisfactory to the shareholders. After making a distribution of 8 per cent. in 1899, and of 7 per cent. in 1900, it had been expected that at least 4 per cent. would be paid for the past year. The disappearance, however, of one of the directors, who has since terminated his earthly existence, led to the discovery of pencil notes showing a heavy deficit for 1901, and an investigation of the books has since indicated a debit balance to the extent of £27,430 for that year. By drawing upon the reserve funds the deficit becomes reduced to £13,563. It turns out that the unfortunate position of the company really extends over both 1900 and 1901, as in the former year some of the assets, amounting to £11,200, were actually booked twice over, so that instead of there having been a profit, an actual deficit was incurred in 1900, when a dividend of 7 per cent. was paid. The present directors attribute the unsatisfactory results to the Vienna branch, the high cost of raw materials, the diminution in sales and expensive experiments which were only concluded at the end of 1901, and which are thought to be full of promise for the future of the undertaking. Whilst stating that the critical situation is still engaging the attention of the directors, it should be mentioned that Herr C. Pollak, the founder of the company, retired from it out of consideration for his health as far back as 1899.

The report for 1901 of the Boese Accumulator and Electricity Company, of Berlin, which holds an exclusive license for the Stone train lighting system in Germany, states that the industrial depression has disadvantageously affected working operations, and this and other causes have largely diminished the financial results. After meeting expenditure, and providing for depreciation, the net profits amount to £10,946, as compared with £37,530 in 1900, and it is proposed to pay a dividend at the rate of 4 per cent., as against 11 per cent. in the preceding year. As far as the Stone system is concerned, the report mentions that 79 railway coaches are now equipped on this principle, including 20 Imperial mail vans, and more favourable prospects exist at the present time for the extension of electric lighting in trains.

The Oberspree Accumulator Company, of Berlin, which was founded in 1899 by the Berlin Company for Electrical Enterprises, with a capital of £150,000, has now passed into the possession of the Berlin Accumulator Company, although the price at which the shares have been acquired has not transpired. Unsuccessful in 1899 and 1900, the position of the Oberspree Company became worse last year, which has closed with a loss of £33,592, and the sale of the undertaking to the Berlin Company is perhaps the best course which could have been pursued under the circumstances.

REFUSE DESTRUCTION: ITS SANITARY AND ITS STEAM RAISING ASPECTS.

BY FRANK BROADBENT, M.I.E.E.

(*Continued from page* 885.)

II.

FROM the data given in the preceding tables, it is possible to calculate approximately the combined calorific value of the mixed materials constituting the refuse, or "dust."

In the following table, which refers to London refuse only, the figures denoting the percentage weight are based upon the average values given in the analyses by Colonel Codrington and Mr. Jos. Russell.

To anticipate the criticism that the figures are not accurate to four places of decimals, it may be confessed that the nearest second figure only has been taken. This is sufficiently accurate, in view of the fact that the analyses are based upon the average values per 1,000 cartloads, which were not weighed to fractions of a pound.

TABLE III.

AVERAGE COMPOSITION AND CALORIFIC VALUE OF LONDON ASH-BIN REFUSE, CONTAINING THE AVERAGE PERCENTAGE OF MOISTURE.

Component parts.	Weight (average) per cent.	Relative calorific value of materials.	Calorific value in 1 lb. of refuse.
Coal	0·35	9,344	32·3
Coke	0 15	8,000	12·0
Bones and offal	0 37	5,314	19·7
Breeze and cinder	25 55	4,000	1,020 0
Rags	0·40	3,334	13·3
Paper, straw, fibrous material and vegetable refuse	13·15	2,534	331·0
Ash	47·0	Nil.	—
Dust and dirt...	9 75	"	—
Bottles	0·48	"	—
Metals, including tins	0·68	"	—
Crockery	1·72	"	—
Glass	·37	"	—
Totals	99·97	—	1,428 6

Assuming, then, that there were no incombustible material at all, the average calorific value per pound of refuse is about half that of paper, fibrous and vegetable matter, and about $\frac{1}{10}$th that of dry coal. As compared with coal, it has the further disadvantage that about 60 per cent. by weight is absolutely incombustible, *e.g.*, glass, crockery, metals, dirt, &c., but which, if the refuse is put into the furnace in the unscreened state, must be raised to a high temperature at the expense of the combustible portions. Clearly, therefore, such material would not support its own combustion, if burned on an ordinary grate, and under ordinary conditions.

It is necessary to surround it with a reverberatory mass of glowing material, either in the shape of other combustibles or a firebrick arch, and in order to maintain a high temperature in the furnace, forced draught is essential. The pressure of the blast must be varied to suit the requirements, but, generally speaking, a pressure of $1\frac{1}{2}$ in. w.g. is found to be sufficient. By such means the burning mass may be kept in a state of incandescence with, or without, the addition of coal or coke, depending upon the nature and state of the refuse.

In addition to this, means must be provided to keep the gases, driven off from the refuse, in contact with the incandescent fuel or firebrick for a sufficient length of time to render them harmless, innocuous and inodorous.

If a load of cold refuse is dumped or shovelled into a hot furnace, the first effect is to reduce the temperature. Then moisture and gases are driven off before the stuff begins to burn; and, if these were permitted to pass directly into the flues and chimney at a comparatively low temperature, the object of the destructor would, to that extent, be defeated. There are, in general, two methods of preventing this; the first being, to warm up or stew the refuse on a dead plate or hearth before it reaches the grate, the gases then passing over the furnace; and the second, to provide a combustion chamber beyond the furnace, this chamber being kept at a temperature approaching 2,000° F. A combination embodying the features of the two methods is also used.

It is, of course, important that no stewing of the refuse shall take place before it enters the destructor, and to avoid this the greatest care must be taken in designing a destructor plant to keep the tipping platform as cool as possible.

In some cases neglect of this precaution, more particularly in furnaces fed from the top, in which case the refuse storage bins are over the flues, above the furnace level, has given rise to objectionable and insanitary smells.

After passing through the flues the inert gases are discharged into the air by means of the chimney. This is, in effect, the only use of the chimney; it is not for the purpose of creating a draught, nor for carrying objectionable fumes to a great height. If the destructor has done its work efficiently, there should be neither smoke, smell, nor colour in the gases issuing from the chimney's mouth.

Sometimes a yellow tinge is observable in the escaping gases. This means dust, not the same as collected by the "dustman," but a very fine, almost impalpable, dust driven off from the furnaces, and possessing a characteristic and obnoxious odour.

The emission of dust is evidence of imperfect design or proportion, as, with a perfectly designed plant, no dust, no smell, no nuisance should be, nor need be, emitted or created.

The dust problem is one that has been met and overcome by experienced destructor makers. Baffle plates in the flues, swirling chambers, on the cream separator principle, and other efficient means are used; but the most obvious and common-sense method is to keep down the velocity of the gases by providing flues of ample size. The dust will then settle by ordinary gravitation in the flues, and at the base of the chimney.

Having thus dealt, briefly, with the sanitary aspect of the matter, and mentioned in a very general way, the chief requirements to be met in a satisfactory destructor, the way is clear for a consideration of the subject from the steam-raising point of view.

As was mentioned in the opening sentence of these articles, the sole object to be aimed at in designing a refuse destructor should be to thoroughly cremate the refuse; the production of steam should be looked upon as a secondary consideration.

It must not be supposed that the production of steam by means of a destructor is deprecated; by all means, utilise the heat to the best advantage, but on no account must this be done at the expense of efficient and perfect cremation.

Every attempt to specially adapt a destructor to the duty of steam raising, has resulted in impairing its efficiency for both purposes; whilst, on the other hand, every improvement made from the crematory or sanitary point of view, has, at the same time, increased its effectiveness, both as a destructor and as a steam generator, and its efficiency as the one may be taken as a sure guide to its efficiency as the other.

The steam raising properties of a good modern destructor are now so far recognised, that it is becoming the general practice to include a high-pressure boiler as part of the equipment of an up-to-date plant.

As to the best type of boiler to adopt, this is a matter depending entirely upon the nature of the work it has to do. If constancy of steam pressure is desirable as in electric lighting work, then a boiler with large amount of thermal storage is best, as, owing to the necessity for clinkering the furnaces periodically, the temperature of the flue gases is subject to fluctuations which would render the maintenance of constant pressure in, say, a water-tube boiler, difficult, if not impossible. A boiler of the Lancashire type, in which there is a considerable reserve of heat units in the water, does not feel the variation of temperature so much, and for this reason has advantages over the water-tube type

One disadvantage in connection with the Lancashire type of boiler is that when bricked up in front, the man holes, blow-off cock, &c., are not so accessible as when the boiler is used in the ordinary way for coal firing. It is generally necessary to introduce an extra length of piping, and at least one bend between the boiler and the blow-off cock, in order to render the latter accessible at all. This is, of course, an objection, particularly in cases where much scale or sediment is thrown down.

For traction work, pumping, mortar-mixing, and like operations, in which constancy of steam pressure is not so vital as in electric lighting work, any type of boiler that might be used under ordinary coal firing conditions is equally suitable.

(To be continued.)

THE MEXBORO' ELECTRIC LIGHTING AND DESTRUCTOR WORKS.

The combined U.D.C. refuse destructor and electric lighting works were formally opened on the 29th ult.

The system adopted is the low-tension three-wire continuous current system with accumulators.

As a refuse destructor is combined with the steam-raising plant, accumulators form a very important and necessary adjunct, as, by their use, the profitable load on the destructor is levelled up and spread over a longer period than would otherwise be the case.

Three departments of the Council are directly concerned in the working of the installation.

The Sanitary Committee are responsible for the supply of steam, which it is intended shall be raised entirely by the burning of ashpit and other refuse. The Electric Light Committee have control of the works; and the Highway Committee are the principal customers, as public lighting forms a considerable portion of the load.

Public lighting is another very useful factor making for the efficient use of the destructor, as, like accumulators, it tends to prolong the hours of working.

This is not the first attempt in Mexboro' to dispose of the town's refuse by burning. For some years it was burnt in a primitive fashion in an old quarry, the site of which was readily localised by the smell and smoke, which, according to a local account, "were wafted on the summer breeze."

The present destructor is an up-to-date one, by the enterprising firm of Meldrum Bros., Limited.

It is of the three-cell "Simplex" type, having a total grate area of 75 sq. ft.

Each of the three ashpits is provided with two forced draught blowers, controlled from the front, the air of the draught being heated to 350° F. by passing through a regenerator placed in the flues. The heated gases, on leaving the furnaces, pass through a combustion chamber, which, being placed at right angles to the furnace, acts also as a baffle to intercept the dust.

The capacity of the destructor is 20 tons in 16 hours, which works out to about 37½ lbs. per sq. ft. of grate area. We understand, however, that this rate can be increased very considerably when necessary.

The refuse at Mexboro' is considered to be of good calorific value, as, owing to many of the householders being miners, who get free coal, it contains a fair proportion of cinders.

The steam-raising plant consists of two Lancashire boilers, each 24 ft. long by 7 ft. 6 in. in diameter. One of these is heated by the destructor gases, and the other is adapted to be fired by coal.

In both cases hand-firing is adopted; the boiler steam pressure is 150 lbs. per sq. in.

The engine room contains, at present, two coupled sets, capable of developing 50 KW. at 440 to 480 volts, at a speed of 500 r.p.m., and at a steam pressure of 140 lbs. per sq. in. In addition to the generators there is a balancer-booster consisting of four machines coupled together.

Adjoining the engine room is the accumulator room, con-

taining 250 cells, having an output of 600 ampere-hours at a 10-hour rate, or 450 ampere-hours at a 5-hour rate.

The public lighting consists of 213 street lamps, each containing two 16-C.P. lamps and fitted with Prism globes, and 15 enclosed arc lamps of 500 C.P. Attached to each arc lamp pillar are two 25-C.P. incandescent lamps, which are lighted after midnight, when the arcs are switched off. The incandescent lamps in the street pillars can be switched off independently. The street lighting generally is controlled from six switch pillars, and it is intended that an attendant shall cycle round to turn the lamps on or off. It is calculated that this can be done in 20 minutes. The street lights are supplied from the distributors which supply the private lighting. All the Council's premises are wired, including the Market Hall and the Free Library.

The public lighting replaces 139 gas lights of lower candle-power, which formerly cost the Council £400 a year.

Up to the present the following lengths of cable have been laid :—1,800 yards of feeders, 2,600 yards of distributors, and 10,000 yards of public lighting cables.

The principal contractors, and the approximate amounts of their contracts, were :—

Buildings, G. H. Smith	£4,100
Destructor and one boiler, Meldrum Bros., Ltd. ...	1,930
One boiler, Tinkers, Limited	532
Piping, Aiton & Co.	350
Travelling crane, The Chatteris Engineering Co....	120
Generating plant, Mavor & Coulson, Limited ...	1,786
Switchboard, Bertram Thomas	550
Accumulators, Ashmore, Benson & Co.	1,050
Cables, including laying, The Callender Cable Co.	5,600
Street lamps, Prism Globe Company	1,050
Meters, cut-outs and sundries	330
Land for site	1,400

LAG AND LEAD.

By W. G. RHODES, M.Sc., M.I.E.E.

A propos of recent correspondence and on account of the uncertainty which still appears to exist with regard to the phase relationship between periodic curves, a careful examination of the question may not be out of place. I will, therefore, endeavour to state the case as clearly as possible in the hope that the terms "phase difference," "lag" and "lead" may in future have perfectly definite meanings.

We will commence with the simple case of two sine curves.

Suppose that the two sine curves

$$i = \text{I} \sin (pt - \alpha)$$
$$e = \text{E} \sin (pt - \beta)$$

(where α and β are each less than π) represent respectively the current passing through a given circuit and the alternating potential difference between its terminals. The two curves will obviously have the same frequency, and the angular difference between their nearest maxima or zero values is $\alpha - \beta$, which is called their difference of phase. If $\alpha - \beta$ is positive a zero value of the current occurs later by a time $\frac{\alpha - \beta}{p}$ than the nearest zero value of the potential difference, and is said to lag behind it by an amount $\alpha - \beta$.

If, on the contrary, $\alpha - \beta$ is negative, the current leads before the potential difference by an amount $\beta - \alpha$.

We are thus led to the following definition:—A sine curve, A, is said to lag behind or lead before another sine curve, B, according as a zero (or maximum) value of A occurs later or earlier in point of time than the nearest zero (or maximum) value of the curve B.

Again, the power, P, given to the circuit is

$$\text{P} = \frac{\text{I E}}{2} \cos (\alpha - \beta).$$

That is, the power given to an alternating current circuit is half the product of the maxima values of P.D. and current (or the product of the root mean square values of P.D. and current) multiplied by the cosine of their phase difference.

Notice that the expression for power gives no information whatever as to whether the current lags behind or leads before the P.D. All that we can state is that the phase difference between an alternating current and P.D. capable of representation by means of simple sine curves is the angle whose cosine equals in magnitude the factor (less than unity), by which half the product of the maxima values of current and P.D. must be multiplied in order to give the power given to the circuit.

The quantity cos $(\alpha - \beta)$ is called the "power factor," so that the power factor is the cosine of the phase difference.

If the power factor is unity, $\alpha = \beta$ and the zero and maxima values of the two curves occur simultaneously.

If the power factor is less than unity (it cannot be greater) and the zero values of the current and P.D. occur simultaneously, then either current, or P.D., or both cannot be represented by sine curves.

The question, therefore, arises: What are we to understand by difference of phase in cases where the current and P.D. are not capable of representation by sine curves?

We have given two definitions of phase difference in the case where both current and P.D. are simple sine functions of the time. To suit our own purpose, we proceed to investigate the more general problem by first taking the definition of phase difference to be the angle whose cosine is the power factor of the circuit.

In the most general case we may take the current and P.D. to be represented respectively by

$$i = \text{I}_1 \sin (pt - \alpha_1) + \text{I}_3 \sin (3\,pt - \alpha_3) + \text{I}_5 \sin (5\,pt - \alpha_5) + \&c.$$
$$e = \text{E}_1 \sin (pt - \beta_1) + \text{E}_3 \sin (3\,pt - \beta_3) + \text{E}_5 \sin (5\,pt - \beta_5) + \&c.,$$

since only odd harmonics occur in curves met with in alternating currents and P.Ds.

Here the power P given to the circuit is—

$$\text{P} = \frac{\text{E}_1 \text{I}_1}{2} \cos (\alpha_1 - \beta_1) + \frac{\text{E}_3 \text{I}_3}{2} \cos (\alpha_3 - \beta_3) + \frac{\text{E}_5 \text{I}_5}{2} \cos (\alpha_5 - \beta_5) + \&c.;$$

and if V and A are respectively the root mean square values of P.D. and current, and cos θ the power factor—

$$\text{V A} \cos\theta = \frac{\text{E}_1 \text{I}_1}{2} \cos (\alpha_1 - \beta_1) + \frac{\text{E}_3 \text{I}_3}{2} \cos (\alpha_3 - \beta_3) + \frac{\text{E}_5 \text{I}_5}{2} \cos (\alpha_5 - \beta_5) + \&c.$$
$$= \frac{r}{2} \left\{ \frac{\text{E}_1^2}{r^2 + p^2 \text{L}^2} + \frac{\text{E}_3^2}{r^2 + 3^2 p^2 \text{L}^2} + \frac{\text{E}_5^2}{r^2 + 5^2 p^2 \text{L}^2} + \ldots \right\},$$

where r is the ohmic resistance and L the inductance of the circuit.

Now, for a given P.D. curve, $\text{E}_1, \text{E}_2 \ldots$ and p are fixed, so that for a given circuit cos θ has a perfectly definite value, and we may call θ the equivalent difference between the current and P.D.

In this general case the zero values of current and P.D. can only occur simultaneously if—

$$\text{I}_1 \sin (pt - \alpha_1) + \text{I}_3 \sin (3\,pt - \alpha_3) + \ldots = 0$$
and $$\text{E}_1 \sin (pt - \beta_1) + \text{E}_3 \sin (3\,pt - \beta_3) + \ldots = 0$$

are satisfied by the same value of sin pt.

If we take the simpler case in which one curve is a sine curve, and put—

$$i = \text{I}_1 \sin (pt - \alpha_1) + \text{I}_3 \sin (3\,pt - \alpha_3) + \&c.$$
$$e = \text{E}_1 \sin (pt - \beta_1),$$

the expression for the power reduces to

$$\text{V A} \cos\theta = \frac{\text{E}_1 \text{I}_1}{2} \cos (\alpha_1 - \beta_1),$$

where $$\text{V} = \frac{\text{E}_1}{\sqrt{2}}$$

and $$\text{A} = \sqrt{\frac{\text{I}_1^2 + \text{I}_3^2 + \ldots}{2}}.$$

Here, again, θ is the equivalent phase difference. We must be careful to avoid the mistake of calling $\alpha_1 - \beta_1$ the phase difference, for

$$\cos\theta = \frac{\text{I}_1 \cos (\alpha_1 - \beta_1)}{\sqrt{\text{I}_1^2 + \text{I}_3^2 + \ldots}},$$

and θ does not equal $a_1 - \beta_1$ unless I_3, I_5, &c., are each zero, that is, unless both curves are sine curves.

The values of P.D. and current will occur simultaneously if

$$I_1 \sin (a_1 - \beta_1) + I_3 \sin (a_3 - 3\beta_1) + \ldots = 0.$$

The difference of phase between two periodic curves representing P.D. and current is thus seen to be that difference of phase, θ, which must be given to their equivalent sine curves

$$i = I \sin (pt \pm \theta)$$
$$e = E \sin pt$$

in order that $\frac{E I}{2} \cos \theta$ may be equal to the power given to the circuit.

We cannot, in general, tell from theoretical considerations whether the current lags behind or leads before the P.D., but this can easily be decided by an observation of the effect on the power factor of placing inductance in the circuit.

If we speak of the phase difference between an alternating current and P.D., we mean the angle whose cosine is the power factor of the circuit, and we may call this the equivalent phase difference between the two curves.

Our justification for this statement is, that the mean square value of the curve

$$i = I_1 \sin (pt - a_1) + I_3 \sin (3\,pt - a_3) + \&c.,$$

$$\sqrt{\frac{I_1^2 + I_3^2 + \ldots}{2}}$$

which is independent of a_1, a_3, &c.; that is, the equivalent sine curve is independent of the relative positions of the fundamental curve and the higher harmonics.

SOME POINTS IN SWITCH CONSTRUCTION.

By ALF. H. MAYES.

In these days of careful design, the finished article, after a few years' experience in its manufacture, generally approaches perfection by the usual process of evolution, or, in other words, gradual elimination of its weakest points.

It is, therefore, somewhat surprising that switches, such as are ordinarily used for electric lighting and power installations, and for which such a universal demand exists, should, in many cases, still retain the defects which characterised those of the earliest construction.

Looking at some designs of main switches, classed as suitable for use on 250-volt circuits in the lists of our leading makers, one cannot fail to observe the marked want of proportion which exists, comparing the gap allowed between the switch contacts and the arc through which the contact maker is caused to pass when the switch is opened.

In a typical case, the distance between the contacts of a single pole 25-ampere 250-volt switch was found to be $1\frac{1}{8}$ in., whilst the distance between the contact maker and the contacts when the switch was open was $1\frac{1}{2}$ in. If, therefore, an arc were formed on opening the switch, it is absolutely certain that it would form between the switch contacts, inasmuch as the only other path open would be from one switch contact to the contact maker, and then to the other contact forming a double arc, having a total length of 3 in.

From an extended use of this class of apparatus the writer is of opinion that the $1\frac{1}{8}$ in. gap provided between the contacts in this case is quite insufficient, and that in breaking a current of 25 amperes at 250 volts an arc would frequently form.

The difference between the operation of single and double-pole switches is not sufficiently appreciated, as we almost universally find the same width of gap allowed between the contacts whether in the case of single or double-pole switches for any given voltage; the designers having apparently overlooked the fact that to be proportionate the gap in the case of the single-pole switch should be twice that allowed in the double-pole, as in the latter case there are two spaces in the circuit for the arc to bridge over. This applies where a separate switch is provided for each pole, as they are almost certain to be opened independently.

Turning to the knife or chopper type of switch which is so rapidly coming into favour, one finds even greater disparity between the foregoing dimensions and breaks allowed, for in the case of a 50-ampere 250-volt switch, the contacts which grip the blade were placed only $1\frac{1}{4}$ in. apart, whilst it was thought necessary for the contact making blade to attain a position almost at right angles to the switch base when the switch was open. As in the previous instance, the space between the switch contacts is much too small, whilst the arc through which the contact blade travels is unnecessarily large.

When the switches are frequently used, there is great liability of nuts, &c., working loose owing to the difficulty of tightening sufficiently in the first instance against the brittle slate or porcelain bases used. This trouble could easily be overcome by placing spring washers where required.

When single-pole switches are coupled up in order to form those of the double or triple-pole type, trouble is often experienced owing to the unsubstantial nature of the coupling bar provided, whilst the handles frequently work loose.

In place of the coupling bar of wood or fibre so often employed, it would be far more mechanical and satisfactory to fit a metal bar, and to carefully bush all holes with ebonite in order to obtain the necessary insulation. This would also allow the handles to be fitted in a more substantial manner.

In the well-known tumbler class of switch so largely used on account of their cheapness, the insufficiency of space between the contacts is extremely marked, a break of from half to three-eighths of an inch only being allowed in a 25-ampere 220-volt switch. These are largely used as main switches, one on each pole, for lighting installations, and under such conditions are seldom if ever called upon to break the full current for which they are designed, the work usually falling to the branch switches, but should circumstances arise necessitating that the full current be broken on a switch of this class, an arc would certainly form.

In giving the above details the writer has endeavoured to strike a fair average amongst the productions of our leading switch manufacturing firms, and as his conclusions are the result of practical experience, he trusts that these few remarks may not be altogether without influence in the direction of removing such easily-remedied faults.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

11,922. "Hilhouse's electric night gun sight corrector." G. Hilhouse. May 26th.

11,940. "Improved 'Frog' for overhead conductors or lines of electric tramways or railways." The Palatine Engineering Company, Limited, and R. Blakiston. May 26th. (Complete.)

11,950. "Improved brush-holder for dynamo-electric generators and motors and the like." C. Mitchell. May 26th. (Complete.)

11,970. "Improvements in and relating to radiators." P. Ramier and A. Marchal. May 26th.

11,971. "Improvements in and connected with electric incandescent lamps. J. O. Rhodes. May 26th.

11,972 "Improvements in electric accumulator plates." A. Fischer. May 26th.

11,973. "Improvements in negative plates for electric accumulators." A. Fischer. May 26th.

11,994. "Improvements in circuit-closing devices for the line selectors of telephones." O Graetzer. May 26th. (Complete.)

12,003. "An improved feeder pillar for electric tramway and power distribut on." C. Beckingsale. May 27th.

12,030. "An improved electric autocar for conveying heavy articles in factories and the like." C. Heuze. May 27th.

12,075. "An improved method of waterproofing electrical insulating or other materials." W. A. Phillips. May 27th.

12,078. "Improvements in electrical transformers." H. H. Lake. (General Electric Company, United States.) May 27th.

12,079. "Improvements relating to the laminated cores of dynamo-electric machines." H. H. Lake. (General Electric Company, United States.) May 27th.

12,080. "Improvements relating to the field magnets of dynamo-electric machines." H H. Lake. (General Electric Company, United States.) May 27th.

12,081. "Improvements relating to lubricating devices for the trolley wheels of electric railway cars and the like." H. H. Lake. (General Electric Company, United States.) May 27th.

12,082. "Improvements in transfer wagons or trucks for use in the distribution of freights at railway stations or other localities." H. H. LAKE. (General Electric Company, United States.) May 27th.

12,088. "Improvements in or relating to electric arc lamps." H. H. LAKE. (General Electric Company, United States.) May 27th.

12,090. "Improvements in and relating to staying telegraph and telephone poles and the like." C. E. EGNER and H. C. P. CELION. May 27th. (Complete.)

12,106. "Improvements in pull-down devices for the trolley-poles of electric cars and the like." J. I. SOUDET and J. TURRI. May 27th.

12,121. "Improvements in and relating to telegraphic apparatus." A. DAMASKINOS. May 27th. (Complete.)

12,129. "Improvements in electric arc lamps." F. M. LEWIS and H. S. HATFIELD. May 27th.

12,156. "Improvements in electric incandescence lamps." C. D. ABEL. (Siemens & Halske, Aktein Gesellschaft, Germany.) May 28th.

12,157. "An improvement in the manufacture of filaments or the like for electrical incandescence lamps." C. D. ABEL. (Siemens & Halske, Aktein Gesellschaft, Germany.) May 28th.

12,158. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. ABEL. (Siemens & Halske, Aktein Gesellschaft, Germany.) May 28th.

12,159. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. ABEL. (Siemens & Halske, Aktein Gesellschaft, Germany.) May 28th.

12,160. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. ABEL. (Siemens & Halske, Aktein Gesellschaft, Germany.) May 28th.

12,161. "Improvements in electrical incandescence lamps." C. D. ABEL. Siemens & Halske, Aktein Gesellschaft, Germany.) May 28th.

12,162. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. ABEL. (Siemens & Halske, Aktien Gesellschaft, Germany.) May 28th.

12,183. "Improved manufacture of electrical glow lamps with osmium filaments." O. IMRAY. (Oesterreichische Gasglühlicht und Electricitäts Gesellschaft, Austria.) May 28th.

12,201. "Improvements in, and relating to, controlling devices for electric motors." H. H. LAKE. (Compagnie de l'Industrie Electrique, Switzerland.) May 29th.

12,205. "Improvements in means for securing cords to fittings; more especially intended for securing flexible electrical conductors with electric light fittings." J. H. GOLDING. May 28th.

12,207. "Electro-thermic ventilator." F. DE MARE. May 28th. Complete.)

12,218. "Improvements in or relating to electric ignition mechanism for internal combustion motors." J. J. H. STURMEY. (C. E. Duryea, United States.) May 29th.

12,231. "Improvements in brushes for dynamos and motors." J. ASPDEN and G. ASPDEN. May 29th.

12,241. "Improvements in or relating to electric arc lamps." H. BREMER. May 29th.

12,262. "Improvements in or relating to permanent ways of electric and other railways." H. PACE. May 29th.

12,290. "Improvements in pressure-regulating apparatus for electric mains." C. TURNBULL, JUN. May 29th.

12,291. "Improvements relating to electric switches." H. H. LAKE. (General Electric Company, United States.) May 29th.

12,292. "Improvements in electrical cut-outs or fuses." H. H. LAKE. (General Electric Company, United States.) May 29th.

12,293. "Improvements relating to electric fuse-boxes." H. H. LAKE. (General Electric Company, United States.) May 29th.

12,294. "Improvements in dynamo-electric machinery." H. H. LAKE. (General Electric Company, United States.) May 29th.

12,301. "Improvements relating to electric motor road vehicles." A. POLLAK. May 29th.

12,309. "An improved electric heating device." F. DE MARE. May 29th. Complete.)

12,316. "Improvements relating to electric railways and tramways." J. WETTER. (A. Sengel, Germany.) May 29th.

12,386. "Improvements in electric generators and motors." J. C. STEWART. May 31st.

12,415. "Improvements in regulators for alternating electric current circuits." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. P. Steinmetz, United States.) May 31st.

12,416. "Improvements in tubulating machines for incandescent electric lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. R. Burrows, United States.) May 31st.

12,438. "Improvements in induction coils." SIEMENS BROS. & CO., LTD. (Siemens & Halske A.G.) May 31st. (Complete)

12,439. "Improvements in or relating to electric safety devices for railways and the like." C. P. JOHANSEN. May 31st.

12,449. "Improvements in means for registering, or metering electrical energy, to be charged for under varying conditions of supply." L. J. ARON. May 31st.

12,458. "Improvements relating to telegraphic perforators." W. JUDD, A. FRASER and G. DRAPER. May 31st.

12,463. "Improvements relating to electrical measuring instruments." E. WESTON and A. O. BENECKE. May 31st.

12,469. "Improvements relating to electrical indicating and recording instruments." E. WESTON and A. O. BENECKE. May 31st. (Complete.)

12,474. "Improvements in wireless telegraphic systems." H. SHOEMAKER. May 31st. (Complete.)

12,476. "Improvements relating to electric recording apparatus chiefly designed for use in connection with electric measuring instruments." E. WESTON and A. O. BENECKE. May 31st. (Complete.)

12,481. "Improvements in electricity maximum demand indicators." G. C. FRICKER and G. H. NISBETT. May 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

6,476. "Improvements in electro-magnetic mechanisms for producing reciprocating motion." W. T. Jones. Dated April 6th, 1900. Relates to electro-magnetic apparatus for producing reciprocating motion. These solenoids are alternately energised and de-energised by the action of suitable switch mechanism, and are thereby caused to attract an iron core first in one direction, then in the other. 6 claims.

6,479. "Improved electric accumulator plates." P. F. Robbe. Dated April 6th, 1900. The electrodes are made from a plate provided with a number of vertical slots. The plate is folded along the line of the slots in order to form a plate. The various folds of each plate are kept apart by perforated strips which is inserted through slots which run slantwise, so that the escape of gas is facilitated. 3 claims.

6,488. "Improved apparatus for simultaneously actuating from one point the controlling switches of the several electrical motor cars of a train." Siemens Bros. and Co. (Siemens Halske). Dated April 6th, 1900. Relates to improvements on the means described in Specification No. 26,649, A.D. 1898, for simultaneously actuating from one point the controlling switches of the several electrical motors of a train. The switches are now driven by suitable gearing from the axles or wheels of the train, or by friction wheels bearing on the rails, instead of by auxiliary motors. 1 claim.

6,496. "Improved means for dropping or cutting out broken overhead conductors on electric railways." F. Skaple. Dated April 6th, 1900. Relates to electric railways with overhead conductors. Supports for conductors constructed to cut out or drop broken lengths by the action of a spring when the tension is released. The ends of the wires are carried by hooks from which they can be ejected by slotted slide bars, which is connected by a spring under tension. 3 claims.

6,499. "An electric motor depending on the electrolytic transport of mercury." R. H. Lehfeldt. Dated April 7th, 1900. Mercury voltameters are made so that the mercury electrodes are confined by rigid porous supports where exposed to the electrolyte, and are allowed to increase and decrease in volume in glass tubes provided with measuring scales. 2 claims.

6,540. "Improvements in or relating to electric railways on the conduit system." M. Stein. Dated April 7th, 1900. Relates to electric railways and tramways on a conduit system. 12 claims.

6,564. "Improvements in reflectors for electric incandescence lamps." R. Gaertner. Dated April 7th, 1900. A reflecting shade for a screw-capped electric incandescent lamp, is made of glass, porcelain or other ceramic material coated internally with a platinum glaze, and united to a moulded neck; this can be slid or screwed on the cap of the lamp, which can then be placed in an ordinary screw threaded holder. 1 claim.

6,568. "Improvements in or relating to the heating of conductors of the second class in electric incandescent lamps." C Raab. Dated April 7th, 1900. Incandescence bodies which conduct only after preliminary heating are connected between the main wires and neutral wire of a three-phase or three-wire system, or between the wires of a two-wire system is the bridge wire of a quadrelateral arrangement of resistances connected between the main wires. The arrangement is such that when the incandescence bodies are normally conductive the combination is balanced electrically, so that no current passes through the neutral wire and heaters. The resistances may be such as to become of higher resistance when carrying current. With alternating currents the resistances may be inductive, or replaced by condensers, and the heaters may be supplied through transformers from the neutral wire. 11 claims.

6,569. "Improvements in or relating to the heating of conductors of the second class in electric incandescent lamps." C. Raab. Dated April 7th, 1900. Incandescence bodies, which conduct only after preliminary heating, are used on alternating current systems in connection with resistances, such as ordinary incandescent lamps, transformers having differentially-disposed primary coils and electrical heaters, which may be of fine platinum wire wound on mica. The heaters are supplied with secondary currents from the transformers, until, by the incandescence bodies becoming conductive, the primary currents be equal and opposite, so that no secondary current is induced. The transformers may have open magnetic circuits, so that their coils serve as inductive resistances in series with the incandescence bodies; transformers without separate secondary coils, as described in Specification No. 5,298, A.D. 1899, may be used. The invention is applicable in various ways on two- and three-wire systems. 7 claims.

6,615. "Improvements in terminals and binding screws for electric batteries and connections." W. R. Edwards. Dated April 9th, 1900. Relates to terminals and binding screws used for making connections in electric batteries, and consists in making them of a finely threaded screw of brass, copper, iron, or steel, on the ends of which are fitted hollow threaded caps of antimoniated lead or other incorrodible material. The face of each cap is provided with a projecting ridge which, when the caps are screwed up, becomes embedded in the plate or electrode, or in soft metal washers, which are interposed between the caps and the electrode, and thereby prevents corroding materials from obtaining access to the screw. 1 claim

6,683. "Improvements in electric transformers." British Thomson-Houston Company. (W. S. Moody). Dated April 10th, 1900. An electric conductor is made tubular, preferably oval in cross-section, for the circulation of a cooling fluid. 20 claims.

6,701. "Improvements in the process of electrolytically-preparing metals or alloys for lithographic purposes." O. C. Strecker. Dated April 10th, 1900. Plates of metal or alloys, such as aluminium, zinc, nickel, copper, or alloys thereof, for use in lithographic printing are provided by electrolysis with a water-retaining layer, either before or after the application of the drawing. When it is required to clean the plate again, the layer is removed by electrolysis. 3 claims.

6,703. "Improvements in magneto-electric machines for igniting purposes." T. Bergmann. Dated April 10th, 1900. A magneto-electric machine for igniting the charge in gas engines, &c., is provided with means for causing the production of the spark either sooner or later with reference to the movement of the oscillating or rotating armatures. 1 claim.

6,704. "Improvements in induction apparatus." C. Vogt. Dated April 10th, 1900. Relates to means for regulating the current and for making and breaking the circuit. The secondary coil is movable on the primary by turning the wheel which engages the rack. A pointer indicates the relative positions of the coils. 3 claims.

6,774. "Improvements in or connected with direct-current transformers." W. L. Spence. Dated April 11th, 1900. In direct transformation by means of a rotary transformer, the primary is converted into a polyphase current, which is supplied to a static transformer, and the secondary current thus obtained is reconverted to a direct current. 3 claims.

6,793. "Automatic regulating switch." F. T. Teichard. Dated April 11th, 1900. Relates to automatic switching apparatus for regulating currents. A voltmeter is adapted to close one or other of two relay circuits when the current varies from the pre-determined limits. In connection with the relays are motors which serve to operate a switch for cutting in or out battery cells. 6 claims.

6,794. "An improved electrical-combined switch and cut-out." H. Eckstein and A. J. D. Krause. Dated April 11th, 1900. Relates to a switch or cut-out in which the switch arm is locked in position by a catch which is controlled by a rod adapted to expand or contract under the influence of an abnormal current. 4 claims.

6,826. "Improvements in switches for electric currents." J. C. Janisch. Dated April 11th, 1900. Relates to switches operated by buttons or plugs for use in lighting, and adapted to close the circuit of a single lamp or a group, or for like purposes. 5 claims.

6,878. "Improvements in electric arc lamps." H. V. James. Dated April 10th, 1900. Relates to electric arc lamps of the clutch type, and is too long for purposes of abridgement. 5 claims.

6,923. "Improvements in loud-speaking telephones." C. F. Dussaud. Dated April 12th, 1900. Loud-speaking receivers are arranged with a number of diaphragms having magnetic centres, and between the diaphragms a number of electro-magnets are arranged in series. The diaphragms divide a cavity into a number of chambers, which are connected to the orifice by openings. 1 claim.

6,931. "Improvements in or connected with the transmission and distribution of electricity." J. G. Lorrain. (F. Bedell, U.S.A.) Dated April 12th, 1900. Relates to the arrangement of conductors, &c., for transmitting energy and also currents for telephonic or telegraphic, &c., communication over the same conductors, and is too complicated for purposes of abridgment. 6 claims.

6,936. "Improvements in switches for electrical circuits." E. F. Moy and Moy, Limited. Dated April 12th, 1900. Relates to improvements upon the quick-break switch described in Specification No. 17,560, A.D. 1890. 1 claim